THE EFFECT OF A SIMULTANEOUS SPEECH DISCRIMINATION TASK ON NAVIGATION IN A VIRTUAL ENVIRONMENT

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THE EFFECT OF A SPEECH DISCRIMINATION TASK ON NAVIGATION IN A VIRTUAL ENVIRONMENT

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SUMMARY

Moving through varied and complex environments every day is something that most people do with ease. However, if the input from the visual system is unavailable (e.g., damage to the optic nerves or smoke in a burning building), navigating and avoiding obstacles becomes much more demanding. It is therefore desirable to develop a navigation aide for use where visual input has become unavailable. There is a small body of research concerning such navigation aides and their efficacy. However, many issues that may have serious human factors repercussions for such a system are unexplored. This study was conducted in order to examine the effect of an attentionally demanding distractor task on wayfinding performance with an audio only navigation aide, in this case the System for Wearable Audio Navigation (SWAN). The distractor task was found to have a significant impact on wayfinding performance, which decreased when both tasks were performed simultaneously. However, performance on the distractor task improved during this time, in some cases reaching performance levels similar to when the distractor task was performed by itself. This result may be due to participants shifting attention to the task they perceive to be more difficult when asked to do both simultaneously, in this case the distractor task.

CHAPTER 1

INTRODUCTION

Moving through varied and complex environments every day is something that most people do with ease. However, if the input from the visual system is unavailable (e.g., damage to the optic nerves or smoke in a burning building), navigating and avoiding obstacles becomes much more demanding. It is therefore highly desirable to develop a navigation aide for use where visual input has become unavailable. There is a small body of research concerning such navigation aides and their efficacy. However, many issues that may have serious human factors repercussions for such a system are unexplored. This study was conducted in order to examine the effect of an attentionally demanding distractor task on wayfinding performance with an audio only navigation aide, in this case the System for Wearable Audio Navigation (SWAN).

Necessity of Nonvisual Navigation

A recent report from the World Health Organization (Resnikoff et al., 2004) estimates the number of visually impaired individuals worldwide to be over 161 million, with nearly 37 million of those individuals being blind. In the United States alone, it has been estimated that there are over 11 million visually impaired persons, more than a million of whom are blind (De l'Aune, 2002). Given these numbers, it is clear that there exists a relatively large group of people for whom navigation can be a serious difficulty. For a blind or visually impaired individual without some form of assistance (e.g., a sighted guide) moving from one location to another is not only a hard task, but also a potentially dangerous one. Errors in navigation (e.g., wandering into a bad neighborhood) or deviations from a path (e.g., stepping into the street) can have serious repercussions and are often more difficult for visually impaired individuals to avoid. This makes the

development of a system to aid visually impaired individuals in navigating the environment very important.

In addition to the blind, there are other individuals who also stand to benefit from the development of a navigation aide. In certain situations sighted individuals may also be denied the use of visual input for navigation, such as when they cannot see (e.g., a firefighter in a smoky building) or their vision is already occupied with another task. Because there are so many instances where individuals may have greatly reduced access to visual input for moving through their environment, the development of a non-visual navigation aide is highly critical to improving their performance. As visual navigation cues are not an option, such a system must use an alternative sensory modality or modalities to convey information to the user. Some attempts have been made to develop such a system using audition.

Existing Interfaces

One of the oldest auditory navigation interfaces is the Personal Guidance System (PGS) (Loomis, Golledge, Klatzky, Speigle, & Tietz, 1994; Loomis, Herbert, & Cicinelli, 1990). The PGS interface consists of a virtual 3D auditory environment where a computer creates spatialized speech beacons such that the beacon is perceived to come from the same place as the object to which the beacon refers (e.g., a doorway). Loomis et al. (1990) found that a "simple" virtual 3D auditory environment has the potential to provide navigation information to a visually impaired traveler, so their system uses speech beacons and spoken directions (e.g., repeating "Left, left, left…") for navigation. Similarly, the Drishti system (Helal, Moore, & Ramachandran, 2001) also uses a synthesized speech interface, very similar to that of PGS, but with a more complex mapping system that takes user preferences and environmental factors into account.

Prior Investigation

The idea of using sound beacons to aid navigation is not a new one. Despite this, relatively little work has been done to examine the effects of such beacons on performance. Tran, Letowski, and Abouchacra (2000) have studied the effect of beacon types on localization and navigation. The 10 beacons used in their studies ranged from pure tones to complex sounds, including both speech and non-speech sounds. They found that beacon type had a significant effect on both number of errors made in localizing the sound (i.e., accuracy) and the user's comfort level. Based on their findings, they suggested that any acoustic beacon intended for use in navigation tasks should be a wide-band non-speech sound. It is also important to note that users in that study reported that speech beacons were found to be more annoying than non-speech beacons by participants.

Given the findings of Tran et al. (2000) that speech as an auditory beacon is harder to localize in a virtual environment than non-speech beacons, and human factors principles suggesting avoidance of the speech channel when not absolutely necessary (e.g., Salvendy, 1997), our own auditory navigation projects (e.g., Walker & Lindsay, in press) have focused on non-speech audio.

Walker and Lindsay (in press) began by studying the effects of beacon sounds on audio-only navigation. They found a significant effect of beacon sound on time efficiency (how quickly a user travels the prescribed path) and path efficiency (how closely a user follows the prescribed path). In particular, of those sounds tested they determined a pink noise burst to be the best in terms of both efficiencies.

Walker and Lindsay (in press) also looked at how the capture radius of an auditory beacon can affect performance. The capture radius of a beacon is the proximity

to a beacon's location a user must achieve before the system will consider the user to have reached the beacon. Their research showed that capture radius can have a significant impact on performance, with radii too large or too small leading to inefficiency and possible real world safety concerns. A radius of 1.5m was the best of those tested.

SWAN

The SWAN system, used in Walker and Lindsay's research, has an auditory interface composed of spatialized, non-speech auditory icons and earcons that aid users in navigation and awareness of features in the environment. Sounds in SWAN are classified as beacon sounds, object sounds, and surface transition sounds.

Beacon sounds are used for navigation, indicating the path the user should follow to reach the desired destination. These sounds are placed (virtually) at waypoints along a route from the user's current location to the destination the user has selected. The sound is spatialized, appearing to emanate from the direction of the waypoint. As a user approaches a waypoint, the tempo of the beacon sound increases. When the user reaches the waypoint, the current beacon sound ceases and the beacon for the next waypoint becomes audible. Using this trail of beacon sounds the SWAN is able to guide users through their environment.

Object sounds and surface transition sounds provide users with information about the environment as they move along the path of beacon sounds. Object sounds indicate features in the environment that could potentially be of interest (e.g., a water fountain or restroom) or hazardous (e.g., a table blocking the hallway). Surface transitions are sounds that denote changes in the surface the user is walking on (e.g., transition from carpet to

tile). These can often indicate important boundaries (e.g., transition from sidewalk to street).

The SWAN interface is designed to be used on a wearable device. Various types of sensors (e.g., GPS) gather information about the user's location and surroundings, which is then displayed via the SWAN audio interface. In addition to the wearable version, there is a virtual environment version for interface development and indoor testing. While SWAN is not the only interface of this kind to have been developed, it does have a potentially important distinction of using non-speech auditory stimuli instead of speech stimuli.

Questions to be Tested

Though the SWAN system was designed using human factors principles and the limited existing research on such a system, there remain important questions to be explored:

1) Sound design. Though Tran et al. (2000) have done work on this, it was important to replicate and extended their work using the SWAN interface. Walker and Lindsay (in press) began this effort. As the auditory beacons are the backbone of the system, exploring what sounds are good beacons and what characteristics of those sounds are important is critical for the SWAN to be effective. A good beacon must be easy to localize, and this has been found to be facilitated by sounds that are broad spectrum and have a short duration.
2) Interaction issues. Another critical aspect of designing this type of interface concerns how the beacons interact with the user and vice versa (i.e., what variables affect users' behavior when using the interface). This includes issues

such as how capture radius affects performance, how closely waypoints should be located, whether front/back confusions are a potential problem, and so on. Walker and Lindsay (in press) have begun examining these issues as well by exploring the effect of varying capture radius on users' performance with the SWAN system. Though there remains work yet to be done, these initial studies have provided a basis for further exploration of these critical issues.

3) Multiple tasks/multiple sounds. This major issue has yet to be examined using the SWAN interface. There is much underlying theoretical research that deals with aspects of a multiple task/multiple sound situation such as signal detection (i.e., can you hear the beacons in these situations?), masking (i.e., are some sounds preventing others from being noticed?), and attentional issues (i.e., can users attend to other sounds/tasks beyond the basic SWAN navigation task?). The present study begins to address research in this line.

Signal Detection and Masking

One of the fundamental issues in any interface is whether the user can detect informative signals from the interface. An extremely informative and elaborate interface is of no benefit if people who use it have difficulty noticing the stimuli that are intended to convey the information. Thus the most basic distinction a person must make is whether the target sound is present or not. In the most likely usage scenarios for the SWAN interface, there will be at least some degree of background noise (cars, etc.), raising the possibility that the user may not detect the relevant audio cues. This situation has been well described by signal detection theory (Swets, Tanner, & Birdsall, 1961). Obviously the desire for this application is to maximize the number of times the SWAN stimuli are

detected (i.e., increase the number of "hits"). Signal detection theory indicates that this can be affected by increasing the discriminability between the background noise and the target, and also by altering a user's response bias. For purposes of the SWAN interface, the most reliable method of improving the detection rate of the target sounds is to increase the discriminability. How this is to be done in an actual implementation is an important issue.

Similar research has been done on masking, which occurs when one stimulus prevents the detection of another. In essence, detection of the target stimulus is prevented by the occurrence of the masking sound. In a signal detection-type paradigm where the target and masker are presented at the same time this is referred to as simultaneous masking. However, there are other types of masking that can also occur. Forward masking occurs when the presentation of the masking sound occurs prior to the presentation of the target sound and the target is less likely to be detected. Similarly backward masking occurs when a masking sound presented just after the target sound lowers the chances of hearing the target. In these last two types of masking the masker is *not* occurring at the same time as the target, but it is still interfering with detection of that target. The properties of these types of masking have been well documented and exploited for practical applications (e.g., compressing .wav sound files to .mp3). It is important that stimulus sounds in the SWAN interface be designed such that the likelihood of their being masked by common background noises is minimized.

Single versus Dual Sound

In addition to detecting the presence of a sound or sounds from the interface, it is also critical that the sounds be distinguishable. When sounds arrive at the ear, they are

nothing more than a series of pressure waves, with no inherent indicators of what source may have generated a given set of waves. With two or more sound sources, the brain must process the waves in order to segregate this collection of waves into what people perceive as distinct sources of sound, a process referred to as auditory scene analysis (Bregman, 1990). Bregman has found several principles that are important in understanding how this analysis is accomplished and what sound characteristics contribute to scene analysis (Bregman, 1993). These principles suggest ways in which the sound presentation in the SWAN system might be structured in order to facilitate their distinction from external sounds. Assuming that users are able to successfully segregate sounds, they then must attend to the appropriate sound and respond correctly.

Attention

There have been many theories and definitions proposed as to what attention is, and the role it plays in how people experience the world around them. At the same time, audition has long played a role in research on attention, probably most famously involving dichotic listening experiments (e.g., Cherry, 1953). In these classic selective attention tasks participants were asked to shadow (repeat back aloud) whatever was heard in one ear, while at the same time a different audio track played in the other ear. Participants were typically asked questions about the unshadowed (i.e., unattended) ear after they had finished the shadowing task. Often participants did not notice features or changes in the stimuli of the unattended ear, such as a change from English to German (Cherry, 1953) or repetition of the same word list thirty-five times (Moray, 1959). Despite evidence that some stimuli in the unattended ear may be processed 'deeply' (i.e., at a semantic level) (Corteen, 1972; Triesman, 1960), participants often fail to recall

hearing stimuli in the unattended ear and do not tend to act on instructions presented in that ear (Moray, 1959).

In research on the SWAN system (Walker & Lindsay, 2003, 2004, in press) I have clearly demonstrated that users of the system are able to successfully navigate when focused solely on the navigation task. While encouraging and informative as a proof of concept and useful for examining interface characteristics, successful performance in a selective attention paradigm is not necessarily reflective of the conditions under which users in the real world would make use of the system. A more likely scenario involves some type of divided attention task, with users (1) monitoring the SWAN for navigation guidance, (2) listening for information about their surroundings such as cars, and (3) performing some other task such as holding a conversation or listening to music. Thus, given the likely usage scenario of SWAN, it is important to consider the effects of attention-dividing tasks on navigation, and vice versa.

Research on auditory divided attention shows that it is often more difficult to perform a listening task if there is a distractor sound or distractor task present. In the case of SWAN usage, the presence of speech is a common distractor to the navigation task. If this speech discrimination stimulus requires an immediate response, it is possible that the delayed response time could result in danger to the user (e.g., reacting more slowly to the sound of screeching car brakes while walking on the sidewalk). It is therefore important in developing an interface such as the SWAN that such scenarios be well understood.

Experimental Validation

Based on the limits of existing research in auditory navigation aide interfaces, it is clear that there are a number of fundamental research questions to be addressed. The

study conducted here was intended to examine the effects of a dual task paradigm on the SWAN interface. If additional, simultaneous tasks harm performance in the SWAN navigation task it will be a significant limitation to the interface. Thus I had participants navigate through maps (i.e., courses) using the virtual version of SWAN, either with or without a concurrent listening task (a speech discrimination task). I considered effects of divided attention on the performance of both tasks.

CHAPTER 2

HYPOTHESES

1) I predicted that when the SWAN navigation task was completed alone, performance would be similar to that found in prior studies using the system (e.g., Walker & Lindsay, in press).
2) When the speech discrimination task was completed alone (i.e., not as a distractor task), performance would be in line with results for the task found in prior work (e.g., Brungart et al. 2001) that has shown a relatively good rate of correct responses depending on the conditions.
3) In the dual task paradigm I expected to see a slight overall decrease in performance for both tasks. Both tasks are similar enough that some decline in performance was likely, however I expected there to be a significantly larger decrease in performance in the speech discrimination task than in the SWAN navigation task because the SWAN navigation task stimuli are constantly present, resulting in less of a decrement in performance due to a lapse in attention to the SWAN navigation task.
4) I expected overall performance on the SWAN navigation task to be better for participants who used the noise beacon sound compared to those who used the sonar beacon sound.
5) My expectation was that participants' subjective workload ratings of each phase of the experiment would remain relatively low, though it would be higher for the dual task portion of the experiment than the single task parts.

CHAPTER 3

METHODS

Participants

Thirty undergraduates from the Georgia Institute of Technology (15 male, 15 female, 18-26 years of age, mean = 21.5, standard deviation = 2.87) participated for course credit. All participants reported normal hearing, and did not have any prior experience with either of the experimental tasks.

SWAN Navigation Task Interface

Tran et al. (2000) studied 10 different stimuli for navigation beacons. Walker and Lindsay (in press) have examined performance with three of these sounds (a pink noise burst, a 1 kHz pure tone and a sonar pulse). In the present study, the stimuli were the two sounds that had led to the best performance in these previous studies (noise and sonar). Both are 1 s long and of equal loudness. Listeners completed the navigation task with one of the sounds that was repeated periodically as a navigation aide.

Stimuli: Speech Discrimination Task

The stimuli in the speech discrimination task consisted of speech sounds drawn from the Coordinate Response Measure (CRM) speech corpus (Bolia, Nelson, Ericson, & Simpson, 2000). These stimuli are recorded speech segments based on a speech intelligibility task developed by Moore (1981). Stimuli in the corpus are composed of phrases in the format "Ready (call sign) go to (color) (number) now." Each phrase is spoken using all possible combinations of call signs ("Arrow," "Baron," "Charlie," "Eagle," "Hopper," "Laker," "Ringo," and "Tiger"), colors ("blue," "green," "red," and

"white") and the numbers one through eight. A sample sentence would be, "Ready Charlie go to green four now." There are four male and four female speakers who each speak all 256 possible call sign/color/number combinations for a total of 2048 phrases in the corpus. All of the phrases are of similar duration across talkers and have been scaled to have the same RMS power. For the purposes of this study, only stimuli from the four male speakers were selected for use in the speech discrimination task. The task required the participant to monitor a series of speech sounds for a given target phrase. The speech target was placed in a stream of auditory stimuli with distracter stimuli similar to the target. This task is very similar to that studied by Brungart et al. (2001) and used a subset of the same stimuli. Participants made a verbal response to indicate the presence of the target and the correct information associated with it.

Apparatus

For the configuration of the experimental equipment see Figure 1.

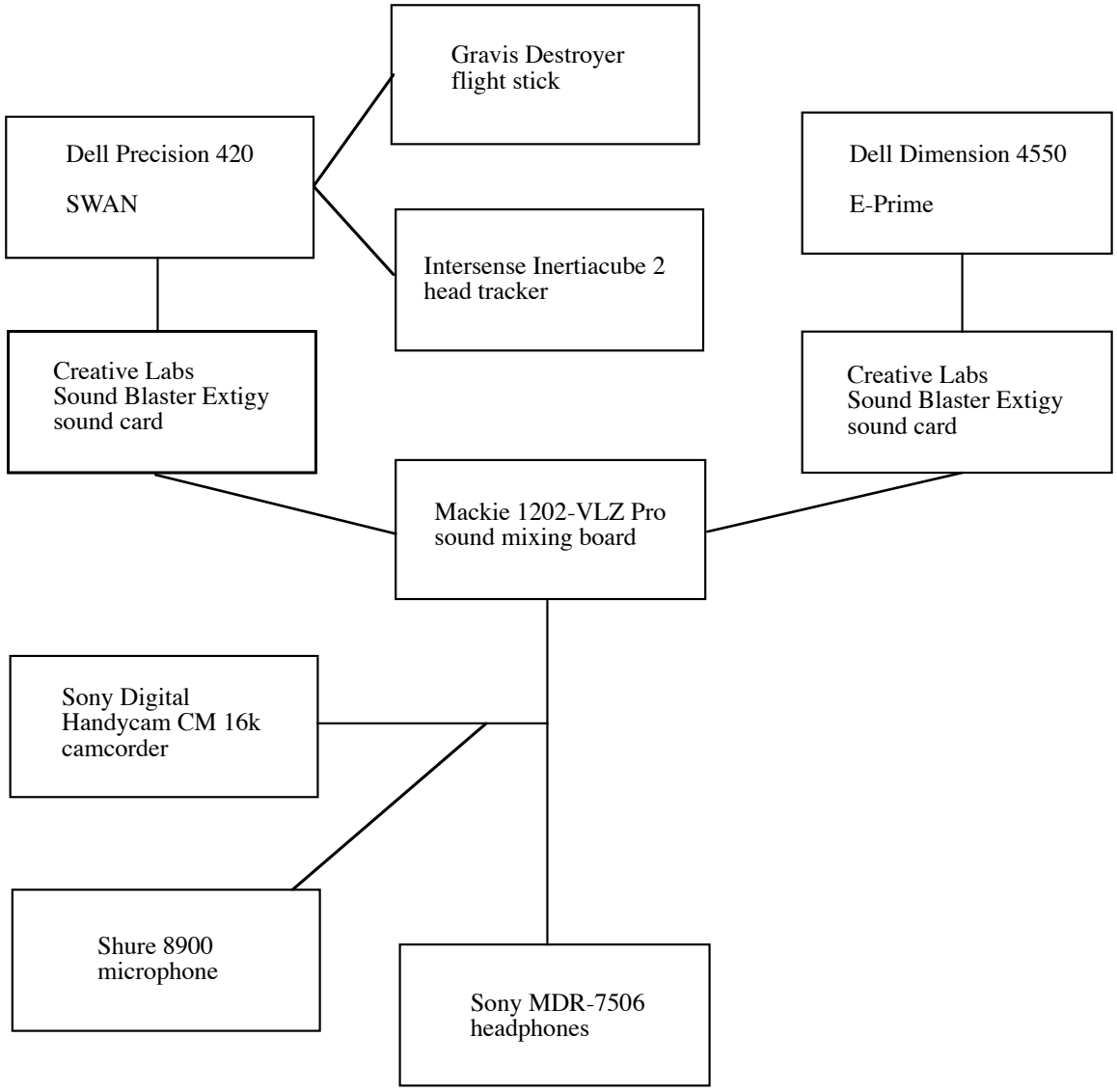

Figure 1: The relation and interaction of the experimental equipment

The navigation task was conducted in a virtual reality environment (VR) built using the Simple Virtual Environments (SVE) software package (Kessler, Kooper, & Hodges, 1998). The study was run on a Dell Precision 420 PC running at 600Mhz with 128MB of RAM. Participants' head position and orientation was recorded using an Intersense InertiaCube 2 head tracker. A Gravis Destroyer PC joystick (Model # 10501) that has been modified into a 'flight stick' controlled a participant's forward and backward

movement within the virtual environment. The base of the joystick has been removed, so that only the stick remains. There are two buttons on the stick, one corresponding to forward movement and the other to backward movement. A Creative Labs SoundBlaster Extigy external sound card performed all the 3D audio rendering using the generalized head related transfer functions (HRTFs) built into the card.

The speech discrimination task was run using a Dell Dimension 4550 running at 2.67 Ghz with 256MB of RAM. The speech stimuli were organized and presented using mp3 file-playing software. The sound was played through a Creative Labs Soundblaster Extigy external sound card. Sound stimuli from the two tasks were mixed on a Mackie 1202-VLZ Pro sound mixing board and played through Sony MDR-7506 closed ear headphones. Experimental sessions were recorded on videotape, allowing the combined SWAN navigation and speech discrimination task audio, the participants' verbal responses, and the person's movements in the VR to all be captured on a single time-stamped video recording.

As mentioned, this study was conducted using the VR version of the SWAN. Given that Tran et al. (2000) found azimuthal localization of an auditory beacon in a virtual environment to be comparable to that of the beacon in a real environment, the use of VR in this study should have had no effect on the results. The use of the VR has several benefits. It drastically reduces the potential for injury to a participant that could otherwise be present in walking without the aid of vision. In addition, having participants navigate through a VR world eliminates the issue of measurement error on the location sensors used in the wearable version of SWAN. Using a VR also allows much tighter

control of the environmental conditions during the experiment. Further, the purpose of this study was to address attentional issues, not locomotion.

A computerized version of the NASA-TLX[1](Hart & Staveland, 1988) was administered to assess subjective workload at various stages of the experiment (see below).

Procedure

As mentioned, there were two tasks in this study, the SWAN beacon navigation task and the speech discrimination task. Figure 2 depicts the flow of the experiment.

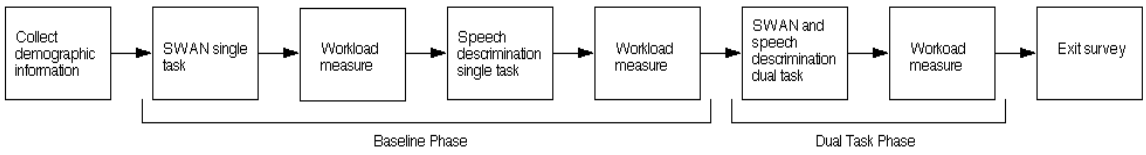

Figure 2: Study outline

In the Baseline phase of the study, participants performed each of the tasks alone (i.e., only the navigation task, then only the discrimination task) as a baseline measurement. When performed alone, the speech discrimination task stimuli were presented sequentially with a 7 s break between trials (see Brungart, 2001). In the Dual Task phase of the study participants were asked to perform the navigation task and the discrimination task simultaneously. When it was a distracter task, the speech discrimination trials were not presented one immediately after the other. Rather, one trial occurred during each

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[1] According to recent work (see Rubio, Diaz, Martin, & Puente, 2004) the NASA-TLX should be adequate to assess the subjective workload perceived by participants during each portion of the study. The NASA-TLX is desirable in the context of this experiment over comparable measures due to the fact that a computer version is readily available and it has a relatively low cost to administer in terms of time.

segment of the map. The point at which it occurred during the segment was determined by a participant's distance from the next beacon's capture radius. This distance was constant across participants, but varied from path segment to path segment. This ensured that a) each participant received an equal number of speech discrimination trials and b) the speech discrimination stimuli were presented when the beacon sound in the SWAN task was at the same tempo for each participant. After each of the three task sets (navigation, discrimination, and navigation+discrimination) participants completed a subjective workload measure.

Data Collection

There were three types of raw data collected during this study:

1) A text file containing time and position data from the SWAN VR system. The text file contains participants' positions within the VR, as well as the pitch, yaw and roll of their head, all recorded approximately every 200 ms.
2) A time-stamped video with an audio track composed of a combination of all the auditory stimuli and the participants' verbal responses. The video is comprised of a time-stamped recording of participants during the study. The audio track in the video consists of the navigation task stimuli, the speech discrimination task stimuli, and the participants' verbal responses to the latter task.
3) The videotape was manually analyzed and coded after the experiment to extract data regarding the speech discrimination task.
4) A text file containing the results of the computerized NASA-TLX inventory.

CHAPTER 4

RESULTS

Participants' position and time were recorded as they performed the navigation task, and were analyzed to compute the dependent variables of path efficiency and time efficiency during the task, as in Walker and Lindsay (in press). These metrics are used in order to allow the distance traveled and the time it takes to travel that distance to be normalized across all the SWAN trials, accounting for the fact that the paths in each trial are not the same length. Participants' speed and accuracy in correctly identifying target phrases were used to measure performance in the speech discrimination task, as in Brungart et al. (2001). By obtaining a baseline measure of performance for each task during the first part of the experiment it was possible to determine if there was a change in performance in either of the two tasks when they were done concurrently.

Initially, the results of the SWAN single task were plotted in terms of time efficiency (Figure 3) and path efficiency (Figure 4) with the plots split by beacon sound. Across trials, the noise beacon lead to a more efficient performance across the task than the sonar beacon, especially with regard to time efficiency. The means and standard errors of these trials can be seen in Table 1.

Table 1: Time and path efficiency means by task and beacon type

	Time Efficiency				Path Efficiency			
	Noise Beacon		Sonar Beacon		Noise Beacon		Sonar Beacon	
	Mean	Std error	Mean	Std error	Mean	Std error	Mean	Std error
SWAN Single Task 1	60.94	8.93	51.91	6.46	51.78	6.74	50.33	6.21
SWAN Single Task 2	126.47	6.00	108.05	5.19	82.52	3.19	74.30	4.31
SWAN Single Task 3	138.26	4.18	104.16	6.24	86.05	4.17	72.68	4.82
SWAN Single Task 4	147.70	7.07	138.89	4.82	88.96	3.76	93.08	2.05
SWAN Single Task 5	144.52	4.38	134.52	4.79	89.88	3.31	88.97	3.12
SWAN Dual Task 1	100.70	3.91	143.24	3.15	44.00	2.59	64.90	1.87
SWAN Dual Task 2	93.93	15.54	76.51	15.66	38.30	9.31	28.60	7.82

Also, as can be seen in Figures 3 and 4, participants are clearly improving according to both metrics as their practice with the system increases. In order to test the statistical significance of these results, a multivariate analysis of variance (MANOVA) was conducted on the results with beacon type as a between participants independent variable and performance across trials (the effect of practice) as a within-subjects independent variable. The two dependent measures were path efficiency and time efficiency. Significant main effects of both beacon type, $F(2,27) = 4.413$, $p < .05$, *Wilk's Lambda* = .754, and practice, $F(8,21) = 114.590$, $p < .05$, *Wilk's Lambda* = .022, were found, moderated by a significant interaction between beacon sound and practice, $F(8,21) = 3.106$, $p < .05$, *Wilk's Lambda* = .458. Further analysis examining each dependent measure singly found a significant difference for both time efficiency, $F(4,112) = 201.601$, $p < .05$, and path efficiency, $F(4,112) = 30.494$, $p < .05$, for practice, but only time efficiency showed a significant effect, $F(4,112) = 3.559$, $p < .05$, for the interaction between beacon type and practice. The Greenhouse-Geisser correction was used to account for possible violations of sphericity.

The goal of the SWAN single task phase of the study had been to get participants to reach an asymptotic level of performance for both measures. This was accomplished

and can be seen in Figures 3 and 4. Given that this had occurred, the main comparison of interest could then be made between performance on the SWAN task in the SWAN single task and the dual task segments of the study. Only the last two trials in the SWAN single task were used in this comparison, since the desired comparison was between peak single task performance and performance during a dual task situation. The means and standard errors of these results can be seen in Table 1.

The dual task only contained two blocks total, both of which were included in the analysis. This comparison showed a clear decrease in performance in terms of both time efficiency and path efficiency during the dual task phase compared to the single task phase for both beacon types. This can be seen clearly in Figure 3 for time efficiency and Figure 4 for path efficiency.

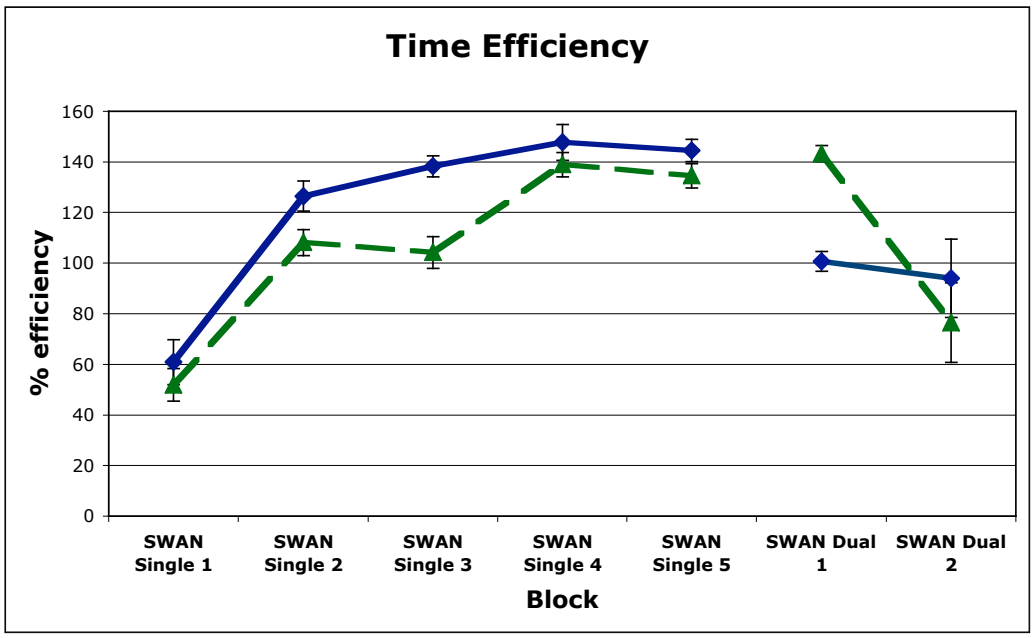

Figure 3: Time efficiencies by beacon type for the SWAN navigation task in the single and dual task phases. The solid line represents the noise beacon and the dashed line represents the sonar beacon.

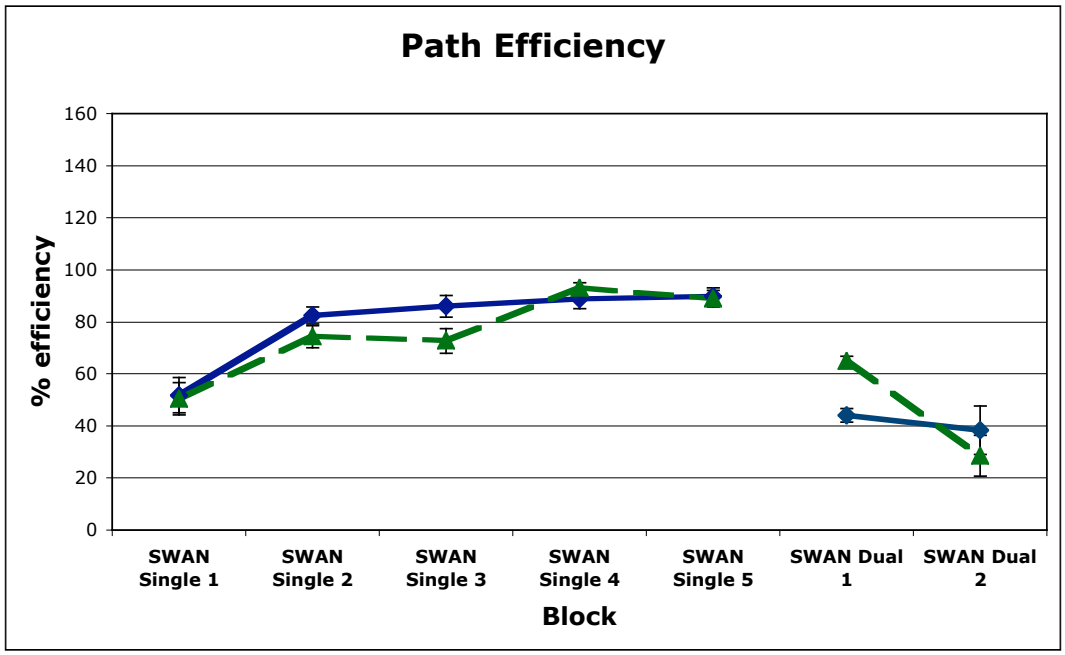

Figure 4: Path efficiencies by beacon type for the SWAN navigation task in the single and dual task phases. The solid line represents the noise beacon and the dashed line represents the sonar beacon.

Interestingly, the different beacon types showed a different rate of decline in performance during the dual task situation than in the single task phase, with the noise beacon not always showing better performance, as it had in the single task phase. These trends can also be seen clearly in Figures 3 and 4. A MANOVA was conducted to test the significance of these observations. Only the last two blocks of trials from the SWAN single task were compared to the two blocks of trials in the dual task portion of the study in this analysis. Beacon sound type was an independent between-subjects variable, and single versus dual task and performance across trials (the effect of practice) were independent within-subjects variables. The dependent measures were again time efficiency and path efficiency. A significant main effect of single versus dual task, $F(2,27) = 52.354$, $p < .05$, *Wilk's Lambda* = .205, was found, moderated by a significant

interaction between the single/dual task condition and beacon sound, $F(2,27) = 4.046$, $p < .05$, *Wilk's Lambda* = .769. No significant main effect of beacon type was found. Further analysis examining each dependent measure singly found a significant effect of single versus dual task for path efficiency, $F(1,28) = 43.851$, $p < .05$, but no such effect for time efficiency. A significant interaction for single versus dual task and beacon type was also found for time efficiency, $F(1,28) = 7.324$, $p < .05$. The Greenhouse-Geisser correction was used in these univariate analyses to account for possible violations of sphericity. These effects can be observed in Figures 3 and 4.

In the speech discrimination task participants' reaction times and accuracy were recorded and compared between the single and dual task phases. The mean reaction times (Figure 5) in the single task (mean = 1.492 s, standard error = .097 s, and mean = 1.232 s, standard error = .080 s in Block 1 and Block 2 respectively) were higher than those in the dual task phase (mean = .890 s, standard error = .063 s and mean = .915 s, standard error = .060 s in Blocks 1 and 2 respectively). Contrastingly, participants' accuracies (Figure 6) during the single task phase (mean = 24%, standard error = 1% and mean = 30%, standard error = 2% in Blocks 1 and 2 respectively) were higher in the first block than in the first dual task block (mean = 15%, standard error = 1%), but by the second block of trials the accuracy during the dual task (mean = 30%, standard error = 2%) had risen to the same levels as in Block 2 of the single task.

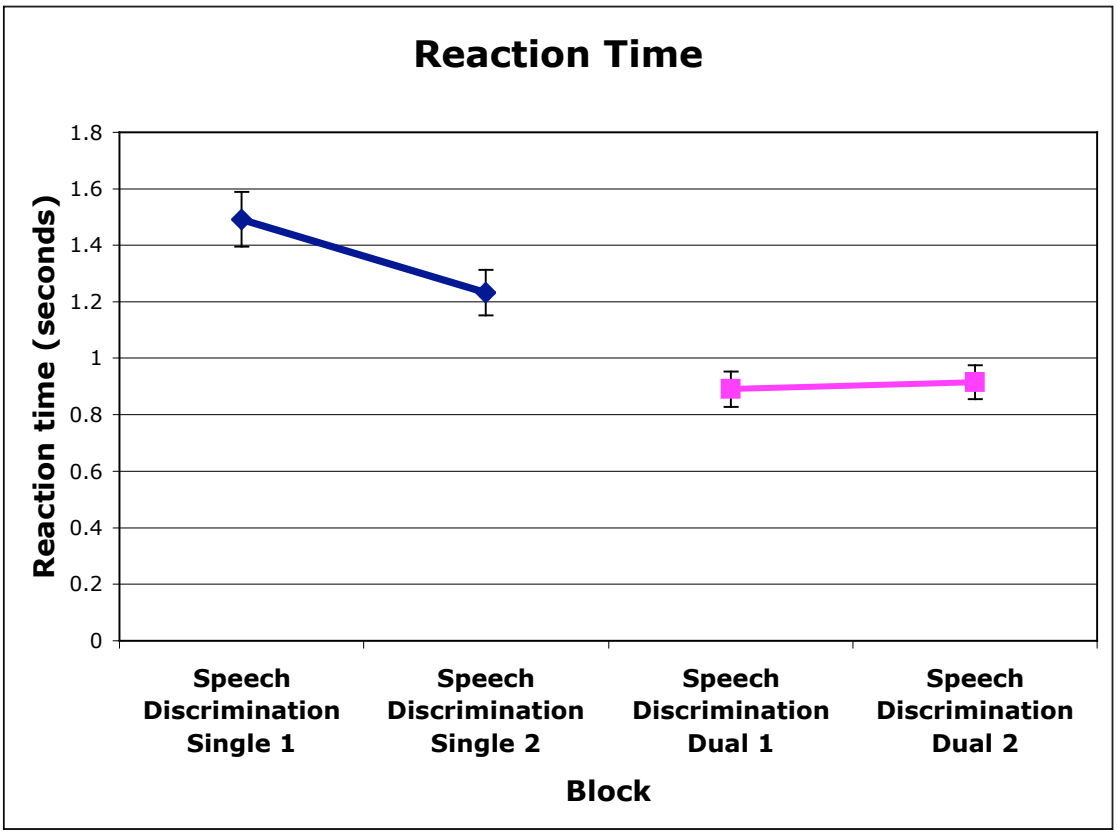

Figure 5: Speech discrimination task reaction times

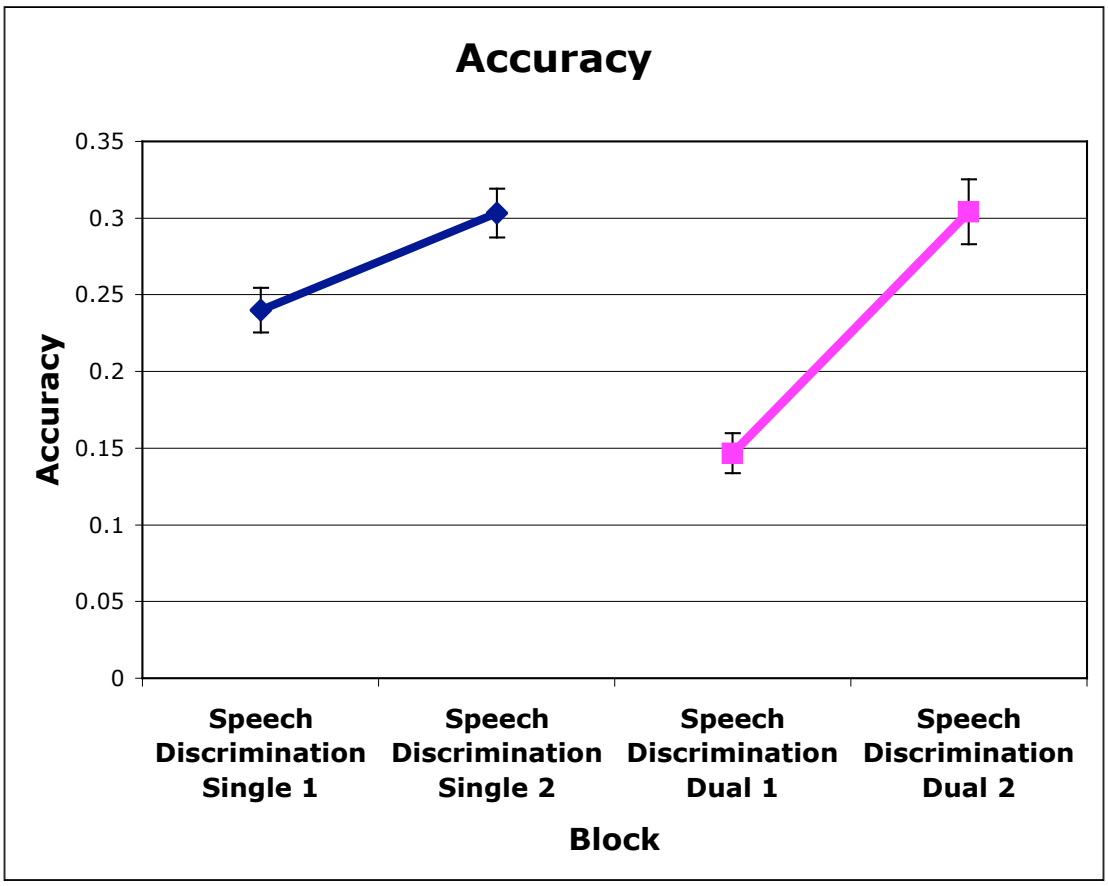

Figure 6: Speech discrimination task accuracy

These observations were analyzed using a MANOVA, with the independent within-subjects variables of single versus dual task and performance across trials (the effect of practice). The dependent measures were reaction time and accuracy. A significant effect, $F(2,27) = 18.920$, $p < .05$, *Wilk's Lambda* = .425, was found for the single and dual task parts of the study as well as for practice, $F(2,27) = 27.703$, $p < .05$, *Wilk's Lambda* = .336, moderated by a significant interaction between these two variables, $F(2,27) = 9.364$, $p < .05$, *Wilk's Lambda* = .599. Both dependent measures were significant for all multivariate effects.

Data recorded from the NASA-TLX were used to calculate a mean reported workload for use in assessing the perceived workload involved in the different task sets. The workload reported during the SWAN single task (mean = 39.42, standard error = 2.97) was much less than that reported during the speech discrimination single task (mean = 67.99, standard error = 3.52). The workload reported during the dual task phase (mean = 69.87, standard error = 3.75) was very close to that reported during the speech discrimination single task and much higher than that reported during the SWAN single task. This trend can be seen in Figure 7.

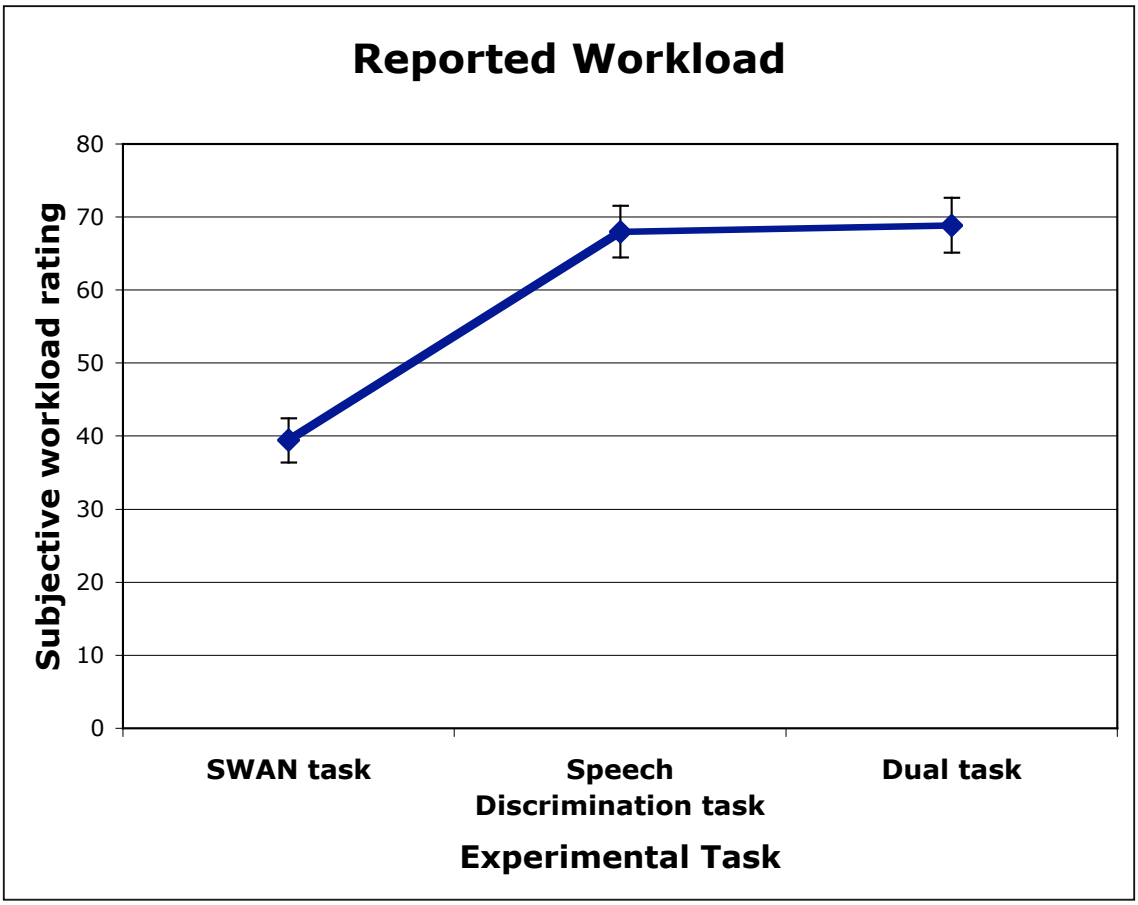

Figure 7: Reported workload

A repeated measures analysis of variance (ANOVA) was performed to test the significance of these observations. The task being performed was the independent variable and reported workload was the dependent measure. This analysis found there to be a significant difference, $F(2,27) = 36.415$, $p < .05$, in reported workload between the different phases of the study. Pairwise comparisons of the three phases using LSD (minimum mean difference = .878) showed a significant difference only between the SWAN single task and the other two tasks.

CHAPTER 5

DISCUSSION

As I predicted, performance in the SWAN single task was similar to performance found in prior work with that task (Walker & Lindsay, in press). The noise burst was once again found to be a better auditory navigation beacon than the sonar pulse. It has been theorized previously by Walker and Lindsay that this result may be due to its ease of localizability as a broad-spectrum noise. It is important to note, however, that while the difference in performance between the two beacon sounds may have been statistically significant, there are other important considerations in terms of practical significance, which will be discussed later.

The time and path efficiencies found in the SWAN navigation task were also similar to those found by Walker and Lindsay (in press). This replication supports their earlier findings of improvement in the navigation task based on practice. Additionally, the number of trials given in this portion of the experiment was beyond the number ever previously given in studies using the SWAN. The results approached asymptotic performance with the SWAN interface using the VR testing environment. This new data will be useful for comparison in future studies using the system. Also, as the asymptotic levels are in regions considered 'very good' performance, these results in the most basic sense demonstrate that people are capable of performing well on the SWAN navigation task after only a modest amount of practice.

Interestingly, the correct response percentage found in the speech discrimination single task was lower than that found in work by Brungart et al. (2001), contrary to what I previously hypothesized. It is possible that the results found in this study differ due to

the variations between the way the speech discrimination task was done in this task compared to the original task used by Brungart et al. (2001). In the original task participants were given the speech stimuli and responded by using a mouse to click a target on a computer screen that matched the correct color and number (i.e. if the answer was 'blue 4' the correct response would be to click on a blue square on the screen that had a 4 inside it). However, participants responded verbally to the speech stimuli in the speech discrimination task in this study. This change in task could be responsible for the varying results. Regardless of the differences, performance in either study when listeners are trying to identify a target talker amidst two masking talkers with the same gender typically shows similarly poor accuracy. It should be noted that participants are performing well above chance (1/32 or 3.125%), but their performance is still not good in terms of practical concerns. Prior work by Brungart et al. (2001) has not included a measure of reaction time, so it is not possible to draw a comparison for that measure. The results of this task, combined with the reported workload would seem to indicate that it is not an easy task to perform, even in a single task paradigm. However, both accuracy and reaction time improved with practice during the single task phase, indicating that participants were able to perform the task. The speech discrimination task is a difficult task it is a good task to include in the dual task paradigm because it ensures that the dual task will be a taxing one.

Having considered the single task results, we arrive at the main question this study was intended to investigate, namely what effect a secondary task would have on performance in the SWAN task. As hypothesized, performance on each of the tasks in the dual task part of the study was worse overall than in the single task phase. This decrease

in performance was observed in the time and path efficiencies of the SWAN task as well as the accuracy and response time in the speech discrimination task. However, I predicted that the largest decrease in performance during the dual task phase would occur in the speech discrimination task. This was not in fact, what occurred. Instead the largest drop in performance was observed in the SWAN task. This was surprising, given that the stimuli in the speech discrimination task are not persistent, and I had therefore hypothesized that performance in the task would suffer more from attentional lapses than the SWAN task with its persistent stimuli. Reasons for this result can be postulated by examining the relationships between the single and dual task performance more closely.

One possible explanation for these results is that participants, who were instructed to perform as well as possible on both tasks during the dual task phase, made a decision (conscious or not) to sacrifice SWAN performance in order to allow more cognitive resources to be devoted to the speech discrimination task. In essence they lessened their effort at what they perceived to be an easier task in order to improve their performance on a more difficult task. This idea is supported by the changes in performance observed between the single and dual task phases for both tasks. In the single task SWAN phase, average performance in terms of path and time efficiencies was very good. Performance increased throughout the single task. However, in the dual task, exactly the opposite occurred. Participants' performances became worse as the dual task phase progressed. Assuming that the difficulty of performing the dual task remained the same at the least, if not improving due to practice, then it would be expected that while performance on the SWAN task might be lower, there would not be a decrease as the dual task phase progressed. At the same time, performance on the speech discrimination task in the dual

task phase was worse than in the single task in the beginning, but by the end of the dual task phase participants' mean accuracy had risen to the same level as the maximum achieved during the single task phase. Also, throughout the dual task phase paricipants' reaction times were faster than during the single task phase. In summary, participants' performance on the SWAN task declined as the dual task phase progressed while their performance on the speech discrimination task improved. This could support the theory that participants started shifting cognitive resources to the speech discrimination task during the dual task phase in order to attempt to maintain performance on that task, which consequently led to fewer resources being available for the SWAN navigation task, thus decreasing performance on that task.

The subjective workload ratings were found to be highest for the dual task portion of the experiment as was hypothesized. However, the reported workload for the speech discrimination single task was almost as high as that of the dual task. Both of these ratings were nearly double the workload rating of the SWAN single task. This suggests that participants, having performed both of the single tasks, did not perceive the dual task to be significantly harder than the speech discrimination task alone. It could indicate that a majority of the workload in the dual task phase was due to the speech discrimination task, but further study with an additional task ordering where the dual task occurred before either of the single tasks would be required to test this hypothesis.

There are important practical implications of these results for the use of the SWAN interface by visually impaired users or users for whom vision is not an option. While participants find the SWAN task has a relatively low workload, it still requires enough cognitive resources (or enough of the same cognitive resources) that introducing

a secondary auditory task can possibly interfere with a user's ability to perform with the interface. This is obviously a potential cause for caution in further design and implementation of this interface. However, there are some important caveats. First, it should be noted that the speech discrimination task used here was a very hard task, which is made apparent both in participants' reported workloads as well as their measured performance. In many common SWAN usage scenarios, it is unlikely that a user would be required to perform another auditory task of this difficulty while using the SWAN, especially for any extended periods. Additionally, users in many cases would simply be able to stop moving and focus on the other auditory task and afterwards they could continue navigating with the SWAN interface. The second key point is that while performance declined during the dual task phase, it is not clear that this drop would have any practical significance in terms of a user's ability to navigate using the SWAN interface. Performance in terms of path and time efficiencies in SWAN single task situations are often high for practiced users, indicating that users are extremely adroit at following the paths indicated by the interface. The moderate drop in performance during the dual task phase observed in this study may be relatively negligible in terms of real world user performance.

While this study demonstrates that a secondary task does decrease SWAN performance, it is not possible to be certain as to the exact nature of the interaction between the two tasks. Further studies would allow this interaction to be examined in more detail. As both tasks are auditory, they definitely will use some of the same cognitive resources. Though the use of non-speech audio in the SWAN task is meant, in part, to avoid clashes with speech-based secondary tasks such as conversations. Future

work to investigate this overlap and its role in decreased performance could also be interesting. Also, replicating this study with an easier or harder version of the speech discrimination task (e.g., less or more masking talkers, differing talker genders, etc.) would be interesting. Changing the secondary task in this way could offer insight in to what levels of difficulty in the secondary task lead to decreased performance on the SWAN task. It could also help to determine if subjectively reported workload is potentially a good indicator of when a secondary task is impairing performance in the SWAN task. This would have obvious practical value when implementing the SWAN system.

APPENDIX A

SWAN DATA

SWAN single task						
Subject	Condition	Map	Time (secs)	Overall Distance	Time Mean	Distance Mean
5	N	1	185.672	241.6814476		
7	N	1	73.032	123.6557539		
9	N	1	80.687	108.8343573		
11	N	1	126.203	146.3201892		
13	N	1	197.89	233.8699737		
15	N	1	131.891	215.5085682		
17	N	1	69.828	116.4795442		
21	N	1	104.625	130.1813748		
23	N	1	316.875	432.7380084		
25	N	1	84.672	137.3605466		
27	N	1	82.688	107.5912145		
29	N	1	59.718	108.584082		
31	N	1	104.344	123.217969		
33	N	1	271.062	564.2571		
35	N	1	162.171	106.4288373	136.7572	193.1139311
5	N	2	202.281	378.8056394		
7	N	2	153.469	343.8909969		
9	N	2	167.656	283.4732317		
11	N	2	202.969	343.951743		
13	N	2	188.625	335.8469286		
15	N	2	239.859	417.4892123		
17	N	2	135	290.2849826		
21	N	2	149.953	298.1347253		
23	N	2	203.218	382.6794738		
25	N	2	200.375	404.9732706		
27	N	2	165.234	299.5261935		
29	N	2	152.797	294.6492013		
31	N	2	260.406	437.1265851		
33	N	2	186.281	359.9312489		
35	N	2	193.563	281.8552243	186.7790667	343.5079105
5	N	3	163.797	293.2118499		
7	N	3	159.078	378.5798235		
9	N	3	189.687	287.5933889		
11	N	3	160.422	287.6678913		
13	N	3	171.312	280.8496912		

15	N	3	201.468	481.4968541		
17	N	3	147.781	285.5419423		
21	N	3	151.922	306.0084222		
23	N	3	178.75	428.1054321		
25	N	3	183.531	398.3289684		
27	N	3	175.312	284.2243729		
29	N	3	157.609	280.4760577		
31	N	3	238.109	447.7818911		
33	N	3	160.985	287.5802885		
35	N	3	160.11	285.4495796	173.3248667	334.1930969
5	N	4	170.531	311.8154269		
7	N	4	139.75	332.4857415		
9	N	4	174.782	307.2867054		
11	N	4	158.047	307.1123449		
13	N	4	178.718	305.8338333		
15	N	4	295.375	652.3438812		
17	N	4	137.969	305.7959927		
21	N	4	151.531	314.4740703		
23	N	4	138.469	341.8006674		
25	N	4	148.438	324.0636672		
27	N	4	173.766	310.0316172		
29	N	4	160.016	306.8500631		
31	N	4	223.656	420.078831		
33	N	4	197.61	351.509338		
35	N	4	159.391	304.5936205	173.8699333	346.4050534
5	N	5	203.75	306.7708126		
7	N	5	146.312	349.3019272		
9	N	5	174.563	303.2655778		
11	N	5	164.297	301.4233148		
13	N	5	160.687	299.0463483		
15	N	5	209.578	505.9769398		
17	N	5	153.141	307.1457458		
21	N	5	151.125	339.2326126		
23	N	5	205.812	465.9087414		
25	N	5	170.187	314.628753		
27	N	5	172.828	305.4636907		
29	N	5	172.25	308.6189781		
31	N	5	173.687	332.5047431		
33	N	5	204.313	319.3685897		
35	N	5	160.297	302.0712644	174.8551333	337.3818693
4	S	1	144.125	218.4019881		
6	S	1	132.188	204.8185076		
10	S	1	173.454	398.0588181		
12	S	1	154.031	157.2288539		
14	S	1	94.906	107.2717953		

16	S	1	158.859	158.0263051		
18	S	1	115.625	183.282497		
20	S	1	117.735	221.7441645		
22	S	1	436.156	331.214707		
24	S	1	105.75	131.6845873		
26	S	1	111.5	116.9823716		
28	S	1	323.25	393.5743501		
30	S	1	181.312	141.2678117		
32	S	1	82.797	108.5864855		
36	S	1	76.078	108.3991837	160.5177333	198.7028284
4	S	2	229.109	411.6749162		
6	S	2	213.187	387.0255139		
10	S	2	253.359	601.5424319		
12	S	2	227.922	342.0643527		
14	S	2	183.141	292.2168916		
16	S	2	223.454	351.3517727		
18	S	2	252.141	414.3069764		
20	S	2	224.969	499.7573489		
22	S	2	282.094	379.4610676		
24	S	2	177.969	295.1352771		
26	S	2	167.344	293.0551374		
28	S	2	301.281	455.1947083		
30	S	2	184.891	288.6470381		
32	S	2	167.484	286.2452415		
36	S	2	190.797	424.9141288	218.6094667	381.5061869
4	S	3	261.297	453.9679578		
6	S	3	198.375	325.8067539		
10	S	3	361.344	856.2832626		
12	S	3	250.891	351.560499		
14	S	3	160.016	283.2625131		
16	S	3	198	311.9853819		
18	S	3	260.329	446.5380114		
20	S	3	205.766	403.1059103		
22	S	3	309.766	456.4707466		
24	S	3	178.938	279.7776346		
26	S	3	237.344	342.1480464		
28	S	3	246.5	427.5723523		
30	S	3	235.453	348.645854		
32	S	3	171.032	281.972155		
36	S	3	175.922	365.7245931	230.0648667	395.6547781
4	S	4	192.016	334.5595664		
6	S	4	199.985	371.7996179		
10	S	4	150.453	364.4947338		
12	S	4	196.907	321.0763024		
14	S	4	163.782	308.8636011		

16	S	4	171.562	317.3234144		
18	S	4	253.735	409.008309		
20	S	4	157.984	354.1263997		
22	S	4	214.484	306.7250339		
24	S	4	172.719	301.8452086		
26	S	4	170.234	312.1802703		
28	S	4	197.25	323.5968423		
30	S	4	182.063	307.0777552		
32	S	4	193.265	304.3733022		
36	S	4	157.062	329.1899659	184.9000667	331.0826882
4	S	5	172.454	302.984031		
6	S	5	165.125	318.908752		
10	S	5	195.781	465.6960456		
12	S	5	205.656	306.4699757		
14	S	5	160.844	303.7988052		
16	S	5	191.563	351.1701588		
18	S	5	272.032	460.9533721		
20	S	5	166.109	359.5549607		
22	S	5	219.516	355.8221716		
24	S	5	170.468	299.1058395		
26	S	5	165.046	299.002651		
28	S	5	210.703	352.2343324		
30	S	5	189.844	306.1298587		
32	S	5	166.078	301.6307347		
36	S	5	166.765	328.9375725	187.8656	340.8266174
Dual task						
Subject	Condition	Map	Time (secs)	Overall Distance	Time Mean	Distance Mean
5	N	1	179.547	543.0585882		
7	N	1	173.953	576.8785601		
9	N	1	154.765	312.1220238		
11	N	1	136.406	332.1050562		
13	N	1	212.781	469.8833887		
15	N	1	379.735	1294.509319		
17	N	1	125.312	339.4761841		
21	N	1	334.406	1133.514117		
23	N	1	591.579	1889.092305		
25	N	1	298.265	944.3800627		
27	N	1	171.953	412.9644969		
29	N	1	185.109	307.9009605		
31	N	1	322.703	944.3311012		
33	N	1	183.266	409.7458563		
35	N	1	264.937	292.902482	247.6478	680.1909668
5	N	2	123.625	318.4881311		

7	N	2	169.687	608.6733811		
9	N	2	126	270.5927132		
11	N	2	104.5	284.0700956		
13	N	2	158.109	326.6637486		
15	N	2	480.359	1787.692716		
17	N	2	108.078	282.6678576		
21	N	2	362.812	1292.203128		
23	N	2	564.797	1847.744254		
25	N	2	271	910.5686588		
27	N	2	339.703	980.5583617		
29	N	2	142	268.1712623		
31	N	2	216.797	524.35135		
33	N	2	191.063	385.8733319		
35	N	2	159.234	264.726179	234.5176	690.2030113
4	S	1	216.687	520.0409882		
6	S	1	204.078	526.5677104		
10	S	1	225.907	866.7632709		
12	S	1	154.562	298.1113834		
14	S	1	122.656	335.1164393		
16	S	1	153.594	377.1401998		
18	S	1	248.719	553.844536		
20	S	1	193.469	630.5379025		
22	S	1	154.032	405.1107394		
24	S	1	114.64	301.692763		
26	S	1	136.687	373.821647		
28	S	1	234.594	699.9478302		
30	S	1	169.406	314.4569068		
32	S	1	137.281	324.4837024		
36	S	1	145.219	389.2489169	174.1020667	461.1256624
4	S	2	181.468	395.2405093		
6	S	2	115.828	345.0802858		
10	S	2	2257.266	8730.194705		
12	S	2	116.735	264.7900397		
14	S	2	133.328	314.9780529		
16	S	2	117.141	296.428792		
18	S	2	354.297	818.3709996		
20	S	2	128.89	276.4536838		
22	S	2	104.625	283.0145074		
24	S	2	104.5	264.7751337		
26	S	2	140.485	324.7795976		
28	S	2	190.828	640.8354363		
30	S	2	138.813	294.2737662		
32	S	2	112.078	276.1296656		
36	S	2	122.312	336.3105102	287.9062667	924.110379

APPENDIX B

SPEECH DISCRIMINATION DATA

Subject #	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring
6	1	00:22.20	00:24.10	00:01.90	0	2	00:31.14	00:34.14	00:03.00	1
7	1	00:16.11	00:21.26	00:05.15	0	2	00:25.19	**00:00.00**	**00:00.00**	0
3	1	00:15.13	00:17.11	00:01.98	1	2	00:24.19	00:25.07	00:00.88	0
4	1	00:21.23	00:23.27	00:02.04	0	2	00:30.27	00:32.25	00:01.98	0
5	1	00:28.27	00:29.17	00:00.90	1	2	00:38.08	00:39.24	00:01.16	0
9	1	00:20.25	00:22.20	00:01.95	0	2	00:29.28	00:31.18	00:01.90	0
10	1	00:24.15	00:25.19	00:01.04	1	2	00:33.17	00:35.13	00:01.96	0
11	1	00:22.14	00:24.09	00:01.95	0	2	00:31.23	00:33.04	00:01.81	0
12	1	00:18.16	00:20.05	00:01.89	1	2	00:27.21	00:28.18	00:00.97	0
13	1	00:15.05	00:16.05	00:01.00	1	2	00:24.10	00:25.11	00:01.01	0
14	1	00:12.23	00:14.22	00:01.99	0	2	00:21.25	00:25.03	00:03.78	0
15	1	00:15.08	00:17.11	00:02.03	1	2	00:24.14	00:25.06	00:00.92	0
16	1	00:25.13	00:28.07	00:02.94	1	2	00:34.17	00:35.07	00:00.90	0
17	1	00:11.16	00:12.07	00:00.91	1	2	00:20.12	00:21.18	00:01.06	0
18	1	00:18.06	00:18.14	00:00.08	0	2	00:27.06	00:27.15	00:00.09	0
20	1	00:14.29	00:16.05	00:01.76	1	2	00:24.04	00:24.29	00:00.25	0
21	1	00:14.19	00:15.15	00:00.96	1	2	00:23.19	00:24.15	00:00.96	0
22	1	00:18.20	00:18.27	00:00.07	1	2	00:28.04	00:28.15	00:00.11	0
23	1	00:14.14	00:15.21	00:01.07	0	2	00:23.20	00:24.15	00:00.95	0
24	1	00:17.01	00:18.00	00:00.99	0	2	00:26.00	00:26.23	00:00.23	0
25	1	00:15.16	00:15.29	00:00.13	1	2	00:24.21	00:25.06	00:00.85	0
26	1	00:14.11	00:15.04	00:00.93	1	2	00:23.14	00:24.11	00:00.97	0
27	1	00:15.29	00:16.29	00:01.00	1	2	00:25.01	00:25.28	00:00.27	0
28	1	00:12.03	00:15.28	00:03.25	0	2	00:20.29	00:21.23	00:00.94	0
29	1	00:12.17	00:13.03	00:00.86	1	2	00:21.20	00:22.09	00:00.89	0
30	1	00:16.08	00:20.06	00:03.98	1	2	00:25.22	00:26.20	00:00.98	0
31	1	00:14.10	00:16.08	00:01.98	1	2	00:23.22	00:25.05	00:01.83	0
32	1	00:13.00	00:14.01	00:01.01	1	2	00:22.09	00:23.09	00:01.00	0
33	1	00:13.07	00:15.29	00:02.22	0	2	00:22.18	00:25.19	00:03.01	0
34	1	00:13.06	00:14.04	00:00.98	1	2	00:22.16	00:23.06	00:00.90	0
35	1	00:12.12	00:15.01	00:02.89	1	2	00:21.20	00:22.12	00:00.92	0

Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #
3	00:40.17	00:41.14	00:00.97	0	4	00:49.26	00:52.26	00:03.00	0	5
3	00:47.25	00:48.08	00:00.83	0	4	**00:57.20**	**00:00.00**	**00:00.00**	0	5
3	00:33.20	00:34.10	00:00.90	0	4	00:42.22	00:43.20	00:00.98	0	5
3	00:40.00	00:41.11	00:01.11	0	4	00:49.16	00:50.26	00:01.10	0	5
3	00:46.28	00:49.12	00:02.84	0	4	00:56.04	00:57.16	00:01.12	0	5
3	00:39.05	00:40.09	00:01.04	0	4	00:48.01	00:50.29	00:02.28	0	5
3	00:42.20	00:44.25	00:02.05	0	4	00:51.20	00:53.08	00:01.88	0	5
3	00:40.20	00:42.27	00:02.07	0	4	00:49.22	00:52.20	00:02.98	0	5
3	00:36.20	00:38.10	00:01.90	0	4	00:45.22	00:48.02	00:02.80	0	5
3	00:33.12	00:34.09	00:00.97	0	4	00:42.12	00:43.26	00:01.14	0	5
3	00:30.25	00:33.27	00:03.02	0	4	00:40.03	**00:00.00**	**00:00.00**	0	5
3	00:33.12	00:34.11	00:00.99	0	4	00:42.23	00:43.02	00:00.79	0	5
3	00:43.20	00:44.07	00:00.87	0	4	00:52.19	00:55.00	00:02.81	0	5
3	00:29.13	00:30.14	00:01.01	0	4	00:38.16	00:40.09	00:01.93	0	5
3	00:36.08	00:36.16	00:00.08	0	4	00:45.04	00:45.10	00:00.06	0	5
3	00:33.06	00:36.04	00:02.98	0	4	00:42.06	00:43.02	00:00.96	0	5
3	00:32.23	00:32.29	00:00.06	0	4	00:41.21	**00:00.00**	**00:00.00**	0	5
3	00:37.03	00:38.12	00:01.09	0	4	00:46.02	00:46.21	00:00.19	0	5
3	00:32.26	00:35.05	00:02.79	0	4	00:41.20	**00:00.00**	**00:00.00**	0	5
3	00:35.00	00:36.22	00:01.22	0	4	00:44.02	00:48.00	00:03.98	0	5
3	00:33.22	00:36.24	00:03.02	0	4	00:42.23	00:46.14	00:03.91	0	5
3	00:32.14	00:33.26	00:01.12	0	4	00:41.16	00:42.12	00:00.96	0	5
3	00:33.28	00:34.24	00:00.96	0	4	00:43.01	00:43.26	00:00.25	0	5
3	00:29.29	00:32.13	00:02.84	0	4	00:39.00	00:39.18	00:00.18	0	5
3	00:30.19	00:31.17	00:00.98	0	4	00:39.20	00:42.07	00:02.87	0	5
3	00:34.18	00:36.07	00:01.89	0	4	00:43.17	00:46.28	00:03.11	0	5
3	00:32.19	00:33.07	00:00.88	0	4	00:41.23	00:43.19	00:01.96	0	5
3	00:31.11	00:32.09	00:00.98	0	4	00:40.15	00:41.04	00:00.89	0	5
3	00:31.19	00:32.24	00:01.05	0	4	00:40.19	00:43.09	00:02.90	0	5
3	00:31.15	00:31.28	00:00.13	0	4	00:40.16	00:41.08	00:00.92	0	5
3	00:30.20	00:31.09	00:00.89	0	4	00:39.23	00:41.18	00:01.95	0	5

Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time
00:58.20	01:00.01	00:01.81	0	6	01:07.20	01:09.14	00:01.94	0	7	01:16.27
01:06.05	01:07.00	00:00.95	0	6	01:15.05	01:15.28	00:00.23	0	7	01:24.05
00:51.24	00:52.14	00:00.90	0	6	01:00.21	01:01.14	00:00.93	0	7	01:09.29
00:58.09	00:59.06	00:00.97	0	6	01:07.11	01:09.13	00:02.02	0	7	01:16.17
01:05.05	01:07.23	00:02.18	0	6	01:14.06	01:14.25	00:00.19	0	7	01:23.11
00:57.13	00:59.13	00:02.00	0	6	01:06.07	01:08.18	00:02.11	0	7	01:15.16
01:00.26	01:01.28	00:01.02	0	6	01:09.24	01:10.15	00:00.91	0	7	01:19.03
00:59.02	01:00.16	00:01.14	0	6	01:07.27	01:09.04	00:01.77	0	7	01:16.28
00:54.24	00:55.24	00:01.00	0	6	01:03.24	01:06.23	00:02.99	0	7	01:12.27
00:51.21	00:53.13	00:01.92	0	6	01:00.14	01:01.11	00:00.97	0	7	01:09.18
00:49.04	00:51.10	00:02.06	0	6	00:58.02	01:01.06	00:03.04	0	7	01:07.07
00:51.22	00:52.14	00:00.92	0	6	01:00.21	01:01.27	00:01.06	0	7	01:09.25
01:01.26	01:03.23	00:01.97	0	6	01:10.23	01:11.27	00:01.04	0	7	01:20.04
00:47.21	00:48.25	00:01.04	0	6	00:56.20	00:59.14	00:02.94	0	7	01:05.21
00:54.10	00:54.23	00:00.13	0	6	01:03.14	01:03.18	00:00.04	0	7	01:12.22
00:51.14	00:55.24	00:04.10	0	6	01:00.15	01:01.00	00:00.85	0	7	01:09.18
00:50.28	00:52.01	00:01.73	0	6	00:59.26	**00:00.00**	**00:00.00**	0	7	01:08.21
00:55.09	00:56.06	00:00.97	0	6	01:04.10	01:04.26	00:00.16	0	7	01:13.13
00:51.02	00:52.11	00:01.09	0	6	00:59.27	01:02.08	00:02.81	0	7	01:09.04
00:53.06	00:55.16	00:02.10	0	6	01:02.04	01:02.29	00:00.25	0	7	01:11.13
00:51.29	00:52.21	00:00.92	0	6	01:00.27	01:01.23	00:00.96	0	7	01:10.03
00:50.23	00:52.07	00:01.84	0	6	00:59.24	01:00.12	00:00.88	0	7	01:09.00
00:52.10	00:53.13	00:01.03	0	6	01:01.28	01:01.27	-00:00.01	0	7	01:10.15
00:48.05	00:50.11	00:02.06	0	6	00:57.04	00:58.20	00:01.16	0	7	01:06.05
00:48.21	00:49.20	00:00.99	0	6	00:57.25	00:59.19	00:01.94	0	7	01:06.27
00:52.29	00:54.10	00:01.81	0	6	01:01.23	01:03.18	00:01.95	0	7	01:11.01
00:50.26	00:51.11	00:00.85	0	6	00:59.29	01:00.09	00:00.80	0	7	01:09.03
00:49.15	00:50.27	00:01.12	0	6	00:58.04	00:59.14	00:01.10	0	7	01:07.23
00:49.26	00:50.05	00:00.79	0	6	00:58.26	01:02.29	00:04.03	0	7	01:07.29
00:49.28	00:50.10	00:00.82	0	6	00:58.25	00:59.09	00:00.84	0	7	01:07.28
00:48.29	00:50.02	00:01.73	0	6	00:57.27	00:59.23	00:01.96	0	7	01:07.02

Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time
01:18.05	00:01.78	0	8	01:25.26	01:27.09	00:01.83	0	9	01:34.27	01:36.10
01:25.07	00:01.02	0	8	01:33.05	01:35.15	00:02.10	0	9	01:42.08	01:44.11
01:10.28	00:00.99	0	8	01:18.27	01:19.25	00:00.98	0	9	01:28.01	01:28.22
01:17.28	00:01.11	0	8	01:25.15	01:26.18	00:01.03	0	9	01:34.19	01:35.11
01:24.01	00:00.90	0	8	01:32.09	01:34.17	00:02.08	0	9	01:41.13	01:44.28
01:18.08	00:02.92	0	8	01:24.14	01:26.06	00:01.92	0	9	01:33.11	01:35.16
01:20.05	00:01.02	0	8	01:27.28	01:28.22	00:00.94	0	9	01:37.00	01:39.07
01:18.24	00:01.96	1	8	01:25.29	01:28.12	00:02.83	0	9	01:35.02	01:37.14
01:16.04	00:03.77	0	8	01:21.28	01:23.03	00:01.75	0	9	01:30.29	01:33.08
01:10.13	00:00.95	0	8	01:18.19	01:19.21	00:01.02	0	9	01:27.21	01:29.08
01:10.25	00:03.18	0	8	01:16.06	01:17.22	00:01.16	0	9	01:25.05	01:27.21
01:11.07	00:01.82	0	8	01:19.00	01:19.22	00:00.22	0	9	01:28.00	01:28.22
01:21.22	00:01.18	0	8	01:28.27	01:29.28	00:01.01	0	9	01:37.00	01:39.00
01:08.11	00:02.90	0	8	01:14.28	01:16.11	00:01.83	0	9	01:23.28	01:25.03
01:12.28	00:00.06	0	8	01:21.13	01:21.20	00:00.07	0	9	01:30.17	01:31.02
01:14.20	00:05.02	0	8	01:18.18	01:19.02	00:00.84	0	9	01:27.20	01:29.08
00:00.00	**00:00.00**	0	8	01:18.00	01:19.27	00:01.27	0	9	01:27.05	01:27.28
01:13.25	00:00.12	0	8	01:18.00	01:23.29	00:05.29	0	9	01:31.13	01:32.02
01:09.12	00:00.08	1	8	01:18.03	01:19.10	00:01.07	0	9	01:27.05	01:29.16
01:14.17	00:03.04	0	8	01:20.10	01:22.26	00:02.16	0	9	01:29.12	01:30.04
01:10.15	00:00.12	0	8	01:19.03	01:20.28	00:01.25	0	9	01:28.04	01:29.01
01:09.20	00:00.20	1	8	01:17.29	01:19.07	00:01.78	0	9	01:26.27	01:27.21
01:11.16	00:01.01	1	8	01:19.15	01:20.10	00:00.95	0	9	01:28.15	01:29.13
01:09.01	00:02.96	0	8	01:15.10	01:17.17	00:02.07	0	9	01:24.07	01:25.02
01:10.13	00:03.86	0	8	01:15.29	01:16.18	00:00.89	0	9	01:25.03	01:25.28
01:12.10	00:01.09	0	8	01:20.01	01:21.17	00:01.16	0	9	01:29.03	01:29.29
01:09.17	00:00.14	0	8	01:18.02	01:18.18	00:00.16	0	9	01:27.03	01:27.20
01:08.19	00:00.96	0	8	01:16.18	01:17.29	00:01.11	0	9	01:25.20	01:26.07
01:12.04	00:04.75	0	8	01:16.29	01:18.04	00:01.75	0	9	01:26.03	01:26.13
01:08.09	00:00.81	0	8	01:16.29	01:17.14	00:00.85	0	9	01:26.00	01:26.15
01:08.18	00:01.16	0	8	01:16.01	01:16.28	00:00.27	0	9	01:25.04	01:27.17

RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT
00:01.83	1	10	01:43.29	01:45.18	00:01.89	1	11	02:02.28	02:05.20	00:02.92
00:02.03	1	10	01:51.06	01:52.16	00:01.10	0	11	02:16.15	02:18.27	00:02.12
00:00.21	1	10	01:37.03	01:38.08	00:01.05	1	11	02:00.28	02:01.27	00:00.99
00:00.92	1	10	01:43.16	01:44.00	00:00.84	1	11	02:05.00	02:06.05	00:01.05
00:03.15	1	10	01:50.12	01:51.00	00:00.88	1	11	02:07.17	02:10.17	00:03.00
00:02.05	1	10	01:42.13	01:44.11	00:01.98	1	11	02:01.18	02:04.12	00:02.94
00:02.07	1	10	01:45.29	01:46.29	00:01.00	1	11	02:08.12	02:09.11	00:00.99
00:02.12	1	10	01:44.02	01:45.13	00:01.11	1	11	02:01.23	02:02.27	00:01.04
00:02.79	1	10	01:40.00	01:44.09	00:04.09	1	11	02:05.15	02:08.25	00:03.10
00:01.87	1	10	01:36.20	01:37.23	00:01.03	0	11	01:55.01	01:56.03	00:01.02
00:02.16	1	10	01:34.09	01:37.25	00:03.16	0	11	01:55.11	01:56.17	00:01.06
00:00.22	0	10	01:36.28	01:38.00	00:01.72	1	11	01:56.04	01:56.20	00:00.16
00:02.00	1	10	01:47.00	01:47.21	00:00.21	0	11	02:04.20	02:06.05	00:01.85
00:01.75	1	10	01:32.24	01:34.27	00:02.03	0	11	01:53.29	01:55.09	00:01.80
00:00.85	0	10	01:39.23	01:40.08	00:00.85	0	11	01:56.17	01:57.22	00:01.05
00:01.88	1	10	01:36.22	01:39.08	00:02.86	1	11	01:57.23	01:58.25	00:01.02
00:00.23	1	10	01:35.29	01:36.24	00:00.95	1	11	02:08.22	02:09.28	00:01.06
00:00.89	1	10	01:40.17	01:41.28	00:01.11	1	11	02:02.24	02:03.04	00:00.80
00:02.11	1	10	01:36.05	01:40.00	00:03.95	1	11	02:00.07	02:00.21	00:00.14
00:00.92	1	10	01:38.13	01:40.13	00:02.00	1	11	01:57.23	02:01.21	00:03.98
00:00.97	1	10	01:37.05	01:38.01	00:00.96	0	11	01:52.15	01:52.28	00:00.13
00:00.94	1	10	01:35.28	01:37.09	00:01.81	1	11	01:53.21	01:55.02	00:01.81
00:00.98	1	10	01:37.12	01:38.26	00:01.14	0	11	01:55.07	01:57.05	00:01.98
00:00.95	1	10	01:33.11	01:35.24	00:02.13	1	11	01:54.00	01:56.06	00:02.06
00:00.25	0	10	01:34.01	01:34.28	00:00.27	1	11	01:50.17	01:52.04	00:01.87
00:00.26	1	10	01:38.03	01:39.19	00:01.16	1	11	01:58.18	01:59.11	00:00.93
00:00.17	0	10	01:36.03	01:36.29	00:00.26	1	11	01:53.09	01:54.08	00:00.99
00:00.87	1	10	01:34.20	01:35.18	00:00.98	1	11	01:49.19	01:50.12	00:00.93
00:00.10	1	10	01:35.05	01:36.05	00:01.00	1	11	01:51.14	01:54.07	00:02.93
00:00.15	1	10	01:35.04	01:35.12	00:00.08	1	11	01:56.05	01:56.15	00:00.10
00:02.13	1	10	01:34.04	01:35.07	00:01.03	1	11	01:51.02	01:52.19	00:01.17

Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring
0	12	02:11.17	02:12.22	00:01.05	1	13	02:20.20	02:23.01	00:02.81	0
0	12	02:25.28	02:26.27	00:00.99	1	13	02:34.27	02:35.21	00:00.94	1
0	12	02:10.07	02:10.22	00:00.15	1	13	02:19.08	02:19.29	00:00.21	0
0	12	02:14.12	02:16.14	00:02.02	0	13	02:23.14	02:23.28	00:00.14	0
0	12	02:16.26	02:17.17	00:00.91	1	13	02:25.27	02:26.15	00:00.88	1
0	12	02:11.05	02:12.13	00:01.08	1	13	02:19.29	02:21.21	00:01.92	1
0	12	02:17.15	02:18.08	00:00.93	1	13	02:26.22	02:27.15	00:00.93	0
0	12	02:10.28	02:12.27	00:01.99	0	13	02:19.29	02:21.17	00:01.88	1
0	12	02:14.19	02:18.16	00:03.97	0	13	02:23.19	02:25.25	00:02.06	0
0	12	02:04.07	02:05.03	00:00.96	1	13	02:13.08	02:14.06	00:00.98	0
0	12	02:04.16	02:05.29	00:01.13	1	13	02:13.20	02:14.21	00:01.01	1
0	12	02:05.09	02:05.20	00:00.11	1	13	02:14.10	02:14.27	00:00.17	0
0	12	02:14.02	02:17.19	00:03.17	0	13	02:23.00	02:24.06	00:01.06	1
0	12	02:03.01	02:04.06	00:01.05	1	13	02:12.03	02:13.44	00:01.41	0
0	12	**02:05.09**	**00:00.00**	**00:00.00**	0	13	02:14.18	02:15.17	00:00.99	0
0	12	02:07.01	02:08.14	00:01.13	0	13	02:16.06	02:19.01	00:02.95	0
0	12	02:17.10	02:17.23	00:00.13	1	13	02:26.14	02:27.03	00:00.89	1
0	12	02:11.23	02:12.19	00:00.96	0	13	02:20.27	02:22.16	00:01.89	0
0	12	02:09.02	02:12.06	00:03.04	0	13	02:18.09	02:18.22	00:00.13	1
1	12	02:06.26	02:10.09	00:03.83	0	13	02:16.03	02:17.00	00:00.97	1
0	12	02:01.14	02:01.27	00:00.13	0	13	02:10.21	02:11.07	00:00.86	1
0	12	02:02.26	02:03.25	00:00.99	0	13	02:12.02	02:12.19	00:00.17	0
0	12	02:04.14	02:05.06	00:00.92	0	13	02:13.15	02:14.17	00:01.02	1
0	12	02:03.03	02:06.03	00:03.00	0	13	02:12.06	02:14.12	00:02.06	1
0	12	01:59.24	02:00.28	00:01.04	0	13	02:08.29	02:09.15	00:00.86	0
0	12	02:07.19	02:08.03	00:00.84	1	13	02:16.22	02:17.15	00:00.93	1
0	12	02:02.17	02:03.02	00:00.85	1	13	02:11.15	02:12.22	00:01.07	0
0	12	01:58.20	01:59.10	00:00.90	0	13	02:07.26	02:08.09	00:00.83	1
0	12	02:00.13	02:01.06	00:00.93	1	13	02:09.23	02:12.10	00:02.87	0
0	12	02:05.02	02:05.15	00:00.13	1	13	02:14.12	02:14.19	00:00.07	0
0	12	02:00.05	02:01.00	00:00.95	1	13	02:09.08	02:10.12	00:01.04	0

Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #
14	02:29.17	02:30.16	00:00.99	1	15	02:38.17	02:40.19	00:02.02	0	16
14	02:43.23	02:45.25	00:02.02	0	15	02:53.00	02:56.00	00:03.00	0	16
14	02:28.03	02:28.25	00:00.22	1	15	02:37.02	02:37.27	00:00.25	0	16
14	02:32.10	02:33.02	00:00.92	1	15	02:41.06	02:42.21	00:01.15	0	16
14	02:34.26	02:35.16	00:00.90	1	15	02:43.20	02:45.09	00:01.89	0	16
14	02:29.01	02:30.08	00:01.07	1	15	02:37.27	02:41.08	00:03.81	0	16
14	02:35.18	02:36.06	00:00.88	1	15	02:44.21	02:45.08	00:00.87	0	16
14	02:28.26	02:30.08	00:01.82	1	15	02:38.00	02:40.13	00:02.13	0	16
14	02:32.19	02:34.03	00:01.84	1	15	02:41.17	02:43.01	00:01.84	0	16
14	02:22.08	02:22.27	00:00.19	1	15	02:31.07	02:32.00	00:00.93	0	16
14	02:22.16	02:26.00	00:03.84	1	15	02:31.14	02:35.17	00:04.03	0	16
14	02:23.09	02:24.05	00:00.96	1	15	02:32.10	02:33.01	00:00.91	0	16
14	02:31.28	02:33.26	00:01.98	0	15	02:40.29	02:42.11	00:01.82	0	16
14	02:21.05	02:22.15	00:01.10	1	15	02:30.00	02:32.04	00:02.04	0	16
14	02:23.19	02:23.22	00:00.03	1	15	02:32.19	02:33.16	00:00.97	0	16
14	02:25.06	02:25.27	00:00.21	1	15	02:34.07	02:35.22	00:01.15	0	16
14	02:35.12	02:35.27	00:00.15	1	15	02:44.09	02:45.17	00:01.08	1	16
14	02:29.25	02:30.11	00:00.86	1	15	02:38.25	02:39.14	00:00.89	0	16
14	02:27.10	02:30.26	00:03.16	0	15	02:36.12	02:37.07	00:00.95	0	16
14	02:25.02	02:25.17	00:00.15	1	15	02:34.02	02:37.22	00:03.20	0	16
14	02:19.19	02:20.03	00:00.84	1	15	02:28.22	02:30.01	00:01.79	0	16
14	02:20.29	02:21.16	00:00.87	1	15	02:30.00	02:30.10	00:00.10	0	16
14	02:22.17	02:23.16	00:00.99	1	15	02:31.20	02:32.18	00:00.98	0	16
14	02:21.05	02:25.16	00:04.11	0	15	02:30.05	02:30.17	00:00.12	0	16
14	02:17.29	02:18.21	00:00.92	1	15	02:26.29	02:28.15	00:01.86	0	16
14	02:25.25	02:29.12	00:03.87	0	15	02:34.22	02:36.12	00:01.90	0	16
14	02:20.22	02:21.25	00:01.03	1	15	02:29.26	02:30.18	00:00.92	0	16
14	02:16.26	02:17.04	00:00.78	1	15	02:25.22	02:26.12	00:00.90	0	16
14	02:18.19	02:19.17	00:00.98	1	15	02:27.19	02:30.18	00:02.99	0	16
14	02:23.08	02:23.22	00:00.14	1	15	02:32.09	02:32.27	00:00.18	0	16
14	02:18.07	02:19.03	00:00.96	1	15	02:27.08	02:28.17	00:01.09	0	16

Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time
02:47.20	02:48.15	00:00.95	1	17	02:56.25	02:57.18	00:00.93	0	18	03:05.24
03:02.02	03:02.18	00:00.16	1	17	03:11.00	03:12.02	00:01.02	0	18	03:20.05
02:46.09	02:46.25	00:00.16	1	17	02:55.09	02:56.06	00:00.97	0	18	03:04.12
02:50.16	02:51.05	00:00.89	1	17	02:59.18	03:00.13	00:00.95	0	18	03:08.20
02:52.26	02:53.14	00:00.88	1	17	**03:02.29**	**00:00.00**	**00:00.00**	0	18	03:11.02
02:47.12	02:48.11	00:00.99	1	17	02:56.08	02:57.21	00:01.13	0	18	03:05.07
02:53.19	02:54.04	00:00.85	1	17	03:02.24	03:03.15	00:00.91	0	18	03:11.23
02:47.05	02:48.11	00:01.06	1	17	02:56.05	02:57.08	00:01.03	0	18	03:05.03
02:50.21	02:51.20	00:00.99	1	17	02:59.24	03:00.27	00:01.03	0	18	03:08.28
02:40.10	02:41.00	00:00.90	1	17	02:49.08	02:50.19	00:01.11	0	18	02:58.14
02:40.17	02:41.25	00:01.08	1	17	02:49.22	02:50.22	00:01.00	0	18	02:58.21
02:41.13	02:41.27	00:00.14	1	17	02:50.20	02:51.22	00:01.02	0	18	02:59.18
02:50.00	02:50.24	00:00.24	1	17	02:59.02	03:00.16	00:01.14	0	18	03:08.08
02:39.06	02:40.05	00:00.99	0	17	02:48.11	02:49.29	00:01.18	0	18	02:57.07
02:41.24	02:41.27	00:00.03	1	17	02:50.25	02:51.02	00:00.77	0	18	03:00.04
02:43.07	02:45.00	00:01.93	0	17	02:52.12	02:53.17	00:01.05	0	18	03:01.00
02:53.12	02:53.24	00:00.12	0	17	03:02.10	03:04.16	00:02.06	0	18	03:11.12
02:47.39	02:48.16	00:00.77	1	17	02:56.29	02:58.29	00:02.00	1	18	03:06.01
02:45.07	02:45.14	00:00.07	1	17	02:54.11	02:54.14	00:00.03	0	18	03:03.13
02:43.02	02:44.10	00:01.08	1	17	02:52.05	02:55.03	00:02.98	0	18	03:01.08
02:37.21	02:38.07	00:00.86	1	17	02:46.24	02:47.06	00:00.82	0	18	02:55.27
02:39.01	02:39.09	00:00.08	1	17	02:47.29	02:48.28	00:00.99	0	18	02:57.03
02:40.20	02:41.17	00:00.97	1	17	02:49.29	02:51.01	00:01.72	0	18	02:59.01
02:39.09	02:39.24	00:00.15	1	17	02:48.13	02:50.07	00:01.94	0	18	02:57.15
02:35.28	02:36.25	00:00.97	1	17	02:45.02	02:46.18	00:01.16	0	18	02:54.05
02:43.29	02:44.14	00:00.85	1	17	02:52.29	02:53.20	00:00.91	0	18	03:02.04
02:38.22	02:39.12	00:00.90	1	17	02:47.28	02:49.12	00:01.84	0	18	02:56.29
02:34.26	02:35.05	00:00.79	1	17	02:43.29	02:45.00	00:01.71	0	18	02:53.00
02:36.21	02:37.10	00:00.89	1	17	02:46.00	02:47.19	00:01.19	0	18	02:55.03
02:41.04	02:41.28	00:00.24	1	17	02:50.20	02:51.03	00:00.83	0	18	02:59.22
02:36.21	02:38.07	00:01.86	1	17	02:45.13	02:47.17	00:02.04	0	18	02:54.15

Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time
03:06.22	00:00.98	0	19	03:14.21	03:15.21	00:01.00	0	20	03:23.28	03:24.17
03:21.07	00:01.02	0	19	03:29.05	03:30.01	00:00.96	0	20	03:37.29	03:38.21
03:05.00	00:00.88	0	19	03:13.09	03:14.06	00:00.97	0	20	03:22.06	03:22.29
03:09.29	00:01.09	0	19	03:17.17	03:18.11	00:00.94	0	20	03:26.19	03:27.14
03:12.09	00:01.07	1	19	03:20.04	03:20.24	00:00.20	0	20	03:29.01	03:29.23
03:06.22	00:01.15	0	19	03:14.11	03:16.00	00:01.89	0	20	03:23.07	03:25.02
03:12.22	00:00.99	0	19	03:20.24	03:21.10	00:00.86	0	20	03:29.20	03:30.08
03:07.13	00:02.10	0	19	03:14.03	03:16.01	00:01.98	0	20	03:23.02	03:24.09
03:09.26	00:00.98	1	19	03:17.24	03:18.20	00:00.96	0	20	03:26.23	03:30.05
02:59.12	00:00.98	0	19	03:07.17	03:08.18	00:01.01	0	20	03:16.09	03:17.03
02:59.16	00:00.95	1	19	03:07.22	03:08.15	00:00.93	0	20	03:16.17	03:19.05
03:00.10	00:00.92	0	19	03:08.19	03:09.00	00:00.81	0	20	03:17.17	03:18.26
03:08.26	00:00.18	0	19	03:17.06	03:18.23	00:01.17	0	20	03:26.06	03:27.05
02:58.15	00:01.08	0	19	03:06.09	03:07.23	00:01.14	0	20	03:15.06	03:16.13
03:00.11	00:00.07	0	19	03:08.23	03:09.02	00:00.79	0	20	03:17.23	03:17.29
03:02.26	00:01.26	1	19	03:10.13	03:11.05	00:00.92	0	20	03:19.11	03:22.02
03:13.14	00:02.02	0	19	03:20.16	03:21.18	00:01.02	0	20	03:29.12	03:30.03
03:07.15	00:01.14	1	19	03:15.06	03:15.28	00:00.22	0	20	03:24.06	03:26.11
03:04.16	00:01.03	0	19	03:12.13	03:12.19	00:00.06	0	20	03:21.11	03:23.05
03:04.02	00:02.94	0	19	03:10.12	03:12.19	00:02.07	0	20	03:19.09	03:20.28
02:56.09	00:00.82	1	19	03:04.26	03:05.21	00:00.95	0	20	03:13.22	03:14.11
02:57.24	00:00.21	0	19	00:06.23	00:07.07	00:00.84	0	20	00:15.22	00:16.04
02:59.26	00:00.25	0	19	03:08.00	03:08.24	00:00.24	0	20	03:16.28	03:17.23
02:57.29	00:00.14	0	19	03:06.13	03:07.13	00:01.00	0	20	03:15.11	03:15.21
02:55.19	00:01.14	0	19	03:03.03	03:04.03	00:01.00	0	20	03:12.02	03:13.19
03:03.12	00:01.08	1	19	03:11.00	03:11.24	00:00.24	0	20	03:20.00	03:21.19
02:58.19	00:01.90	0	19	03:05.24	03:06.22	00:00.98	0	20	03:14.27	03:16.00
02:53.20	00:00.20	0	19	03:01.24	03:02.13	00:00.89	0	20	03:10.26	03:12.05
02:55.29	00:00.26	0	19	03:04.02	03:04.14	00:00.12	0	20	03:12.26	03:16.16
03:00.04	00:00.82	1	19	03:08.20	03:09.00	00:00.80	0	20	03:17.18	03:18.03
02:57.21	00:03.06	0	19	03:03.16	03:05.00	00:01.84	0	20	03:12.08	03:13.15

RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT
00:00.89	0	21	00:32.15	00:33.18	00:01.03	0	22	00:55.24	00:56.21	00:00.97
00:00.92	0	21	00:30.05	00:31.04	00:00.99	1	22	00:51.25	00:52.24	00:00.99
00:00.23	0	21	00:29.19	00:30.02	00:00.83	0	22	00:42.00	00:42.25	00:00.25
00:00.95	0	21	00:56.07	00:56.17	00:00.10	1	22	01:15.15	01:16.07	00:00.92
00:00.22	0	21	00:22.02	00:23.08	00:01.06	0	22	00:37.23	00:38.14	00:00.91
00:01.95	0	21	00:29.18	00:31.06	00:01.88	0	22	00:47.20	00:49.21	00:02.01
00:00.88	0	21	00:19.08	00:19.21	00:00.13	1	22	00:44.13	00:45.09	00:00.96
00:01.07	0	21	00:26.18	00:27.12	00:00.94	0	22	00:44.16	00:46.00	00:01.84
00:03.82	0	21	00:22.27	00:23.24	00:00.97	1	22	00:41.27	00:42.17	00:00.90
00:00.94	0	21	00:39.14	00:40.04	00:00.90	0	22	00:58.03	00:58.20	00:00.17
00:02.88	0	21	00:50.11	00:51.16	00:01.05	0	22	01:04.28	01:05.28	00:01.00
00:01.09	0	21	00:24.20	00:25.08	00:00.88	1	22	00:42.16	00:42.26	00:00.10
00:00.99	0	21	00:26.19	00:27.16	00:00.97	0	22	00:51.08	00:51.26	00:00.18
00:01.07	0	21	00:21.28	00:22.20	00:00.92	1	22	00:47.10	00:48.05	00:00.95
00:00.06	0	21	00:39.21	00:39.26	00:00.05	0	22	01:18.07	01:18.21	00:00.14
00:02.91	0	21	00:21.25	00:23.05	00:01.80	0	22	00:39.03	00:39.19	00:00.16
00:00.91	0	21	00:35.00	00:35.14	00:00.14	0	22	01:09.23	01:10.12	00:00.89
00:02.05	0	21	00:15.26	00:16.03	00:00.77	0	22	00:33.10	00:33.18	00:00.08
00:01.94	0	21	00:22.06	00:23.12	00:01.06	1	22	02:43.10	02:44.04	00:00.94
00:01.19	0	21	00:23.09	00:23.25	00:00.16	1	22	00:39.09	00:40.02	00:00.93
00:00.89	0	21	00:21.10	00:22.06	00:00.96	1	22	00:34.18	00:36.03	00:01.85
00:00.82	0	21	00:26.01	00:26.12	00:00.11	1	22	00:39.21	00:40.02	00:00.81
00:00.95	0	21	00:24.11	00:25.05	00:00.94	1	22	00:42.02	00:42.20	00:00.18
00:00.10	0	21	00:21.25	00:22.21	00:00.96	0	22	00:42.16	00:44.00	00:01.84
00:01.17	0	21	00:16.13	00:16.28	00:00.15	0	22	00:39.09	00:40.14	00:01.05
00:01.19	0	21	00:57.22	00:58.17	00:00.95	0	22	01:27.04	01:27.25	00:00.21
00:01.73	0	21	00:23.05	00:24.01	00:00.96	0	22	00:46.28	00:48.12	00:01.84
00:01.79	0	21	00:29.21	00:30.03	00:00.82	1	22	00:43.14	00:44.02	00:00.88
00:03.90	0	21	00:23.20	00:24.11	00:00.91	1	22	01:09.22	01:11.16	00:01.94
00:00.85	0	21	00:20.04	00:20.19	00:00.15	0	22	00:33.13	00:34.03	00:00.90
00:01.07	0	21	00:29.04	00:29.16	00:00.12	0	22	01:02.21	01:03.02	00:00.81

Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring
1	23	01:16.16	01:17.15	00:00.99	0	24	01:50.29	01:52.00	00:01.71	0
1	23	01:03.20	01:04.08	00:00.88	0	24	01:23.24	01:24.18	00:00.94	0
1	23	01:01.07	01:02.16	00:01.09	0	24	01:44.25	01:45.12	00:00.87	0
1	23	01:24.06	01:24.20	00:00.14	0	24	01:43.29	01:44.07	00:00.78	0
1	23	00:52.21	00:53.12	00:00.91	0	24	01:14.09	01:15.15	00:01.06	0
0	23	00:54.25	00:56.07	00:01.82	0	24	01:16.21	01:17.24	00:01.03	0
1	23	00:50.03	00:51.14	00:01.11	0	24	01:24.20	01:25.02	00:00.82	0
0	23	00:49.18	00:50.16	00:00.98	0	24	01:10.14	01:11.03	00:00.89	0
1	23	00:48.02	00:48.20	00:00.18	0	24	01:10.02	01:10.13	00:00.11	0
1	23	01:03.07	01:04.00	00:00.93	0	24	01:26.19	01:27.02	00:00.83	0
1	23	01:09.12	01:09.29	00:00.17	0	24	01:26.23	01:27.17	00:00.94	0
1	23	01:10.06	01:10.18	00:00.12	0	24	01:50.18	01:51.04	00:00.86	0
1	23	00:54.26	00:55.13	00:00.87	0	24	01:31.17	01:32.03	00:00.86	0
1	23	00:50.23	00:51.24	00:01.01	0	24	01:07.20	01:09.16	00:01.96	0
0	23	**01:26.19**	**00:00.00**	**00:00.00**	0	24	02:00.21	02:01.08	00:00.87	0
1	23	01:15.21	01:16.02	00:00.81	0	24	01:40.01	01:40.08	00:00.07	0
1	23	02:11.20	02:12.22	00:01.02	0	24	02:32.02	02:32.13	00:00.11	0
1	23	00:39.17	00:40.03	00:00.86	0	24	01:10.04	01:10.17	00:00.13	0
1	23	02:50.03	02:52.07	00:02.04	0	24	03:28.10	03:28.19	00:00.09	0
1	23	00:43.09	00:43.20	00:00.11	0	24	01:00.21	01:01.10	00:00.89	0
1	23	01:14.17	01:15.11	00:00.94	0	24	01:48.28	01:49.11	00:00.83	0
1	23	00:43.25	00:44.14	00:00.89	0	24	01:03.13	01:04.03	00:00.90	0
1	23	00:46.04	00:46.21	00:00.17	0	24	01:08.22	01:09.05	00:00.83	0
1	23	00:49.22	00:50.05	00:00.83	0	24	01:08.03	01:08.13	00:00.10	0
1	23	00:46.13	00:47.13	00:01.00	0	24	01:07.21	01:09.07	00:01.86	0
1	23	01:32.11	01:32.29	00:00.18	0	24	01:52.15	01:53.03	00:00.88	0
1	23	00:57.07	00:57.27	00:00.20	0	24	01:16.28	01:17.16	00:00.88	0
1	23	00:48.22	00:49.10	00:00.88	0	24	01:11.03	01:11.16	00:00.13	0
0	23	01:14.23	01:15.20	00:00.97	0	24	01:35.23	01:37.24	00:02.01	0
1	23	00:37.04	00:38.07	00:01.03	0	24	00:59.08	00:59.24	00:00.16	0
1	23	01:12.19	01:13.24	00:01.05	0	24	01:51.24	01:53.03	00:01.79	0

Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #
25	01:59.16	02:00.17	00:01.01	0	26	02:26.18	02:27.17	00:00.99	0	27
25	01:37.21	01:38.10	00:00.89	0	26	01:58.24	02:00.10	00:01.86	0	27
25	01:53.29	01:54.17	00:00.88	1	26	02:02.09	02:02.29	00:00.20	0	27
25	01:50.08	01:50.24	00:00.16	0	26	02:28.08	02:28.20	00:00.12	0	27
25	01:31.14	01:32.04	00:00.90	0	26	02:05.22	02:06.13	00:00.91	0	27
25	01:29.08	01:30.06	00:00.98	0	26	01:39.21	01:41.09	00:01.88	0	27
25	01:40.03	01:40.24	00:00.21	0	26	01:46.24	01:48.01	00:01.77	0	27
25	01:13.25	01:14.16	00:00.91	0	26	01:26.15	01:27.08	00:00.93	0	27
25	01:22.08	01:22.19	00:00.11	0	26	01:38.14	01:39.15	00:01.01	0	27
25	01:55.08	01:55.27	00:00.19	0	26	02:07.11	02:07.28	00:00.17	0	27
25	01:30.29	01:31.17	00:00.88	0	26	01:50.06	01:52.11	00:02.05	0	27
25	02:07.19	02:08.02	00:00.83	0	26	02:40.15	02:40.28	00:00.13	0	27
25	01:38.18	01:39.07	00:00.89	0	26	01:47.01	01:47.24	00:00.23	0	27
25	01:15.03	01:15.27	00:00.24	0	26	01:25.04	01:25.25	00:00.21	0	27
25	02:16.10	02:16.20	00:00.10	0	26	02:30.01	02:30.05	00:00.04	0	27
25	01:43.23	01:43.26	00:00.03	0	26	01:56.18	01:57.02	00:00.84	0	27
25	03:14.28	03:15.11	00:00.83	0	26	03:41.03	03:41.11	00:00.08	0	27
25	01:15.01	01:15.15	00:00.14	0	26	01:32.01	01:32.22	00:00.21	0	27
25	04:28.12	04:28.21	00:00.09	0	26	05:07.16	05:07.16	00:00.00	0	27
25	01:09.28	01:10.26	00:00.98	0	26	01:17.16	01:17.27	00:00.11	0	27
25	02:54.04	02:54.20	00:00.16	0	26	03:52.29	03:53.24	00:00.95	0	27
25	01:07.06	01:07.19	00:00.13	0	26	01:37.29	01:38.11	00:00.82	0	27
25	01:19.07	01:19.21	00:00.14	0	26	01:29.05	01:29.24	00:00.19	0	27
25	01:16.03	01:16.10	00:00.07	0	26	01:48.17	01:49.03	00:00.86	0	27
25	01:21.18	01:22.24	00:01.06	0	26	01:38.26	01:39.27	00:01.01	1	27
25	inaudible	**00:00.00**	**00:00.00**	0	26	02:18.18	02:19.00	00:00.82	0	27
25	02:34.05	02:35.03	00:00.98	0	26	03:04.18	03:05.18	00:01.00	0	27
25	01:14.21	01:15.08	00:00.87	0	26	01:31.20	01:32.13	00:00.93	0	27
25	01:42.11	01:43.19	00:01.08	0	26	02:03.04	02:03.21	00:00.17	0	27
25	01:02.22	01:03.12	00:00.90	0	26	01:18.15	01:19.00	00:00.85	0	27
25	02:02.29	02:03.19	00:00.90	0	26	02:33.20	02:34.12	00:00.92	0	27

Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time
02:42.29	02:44.09	00:01.80	0	28	03:05.10	03:06.22	00:01.12	0	29	03:31.00
02:21.24	02:23.16	00:01.92	0	28	02:41.24	02:42.19	00:00.95	0	29	02:53.21
02:24.06	02:25.05	00:00.99	0	28	02:44.06	02:45.02	00:00.96	0	29	03:14.00
02:48.05	02:49.03	00:00.98	0	28	03:56.17	03:57.15	00:00.98	0	29	04:05.03
02:19.11	02:20.06	00:00.95	0	28	02:36.25	02:39.00	00:02.75	0	29	02:43.22
01:57.16	01:59.24	00:02.08	0	28	02:20.05	02:22.20	00:02.15	0	29	02:32.03
02:32.14	02:33.19	00:01.05	0	28	03:22.18	03:23.03	00:00.85	0	29	03:29.26
01:48.27	01:49.25	00:00.98	1	28	02:07.29	02:09.11	00:01.82	0	29	02:15.07
01:56.08	01:57.16	00:01.08	0	28	02:17.02	02:17.21	00:00.19	0	29	02:28.20
02:50.20	02:51.12	00:00.92	0	28	03:17.27	03:18.16	00:00.89	0	29	03:32.08
02:04.04	02:06.08	00:02.04	0	28	02:22.25	02:24.07	00:01.82	0	29	02:31.12
03:16.08	03:17.18	00:01.10	0	28	04:26.06	04:28.03	00:01.97	0	29	05:24.26
02:03.25	02:04.20	00:00.95	0	28	02:25.04	02:25.22	00:00.18	0	29	02:32.25
01:39.27	01:40.21	00:00.94	0	28	01:57.03	01:58.02	00:00.99	0	29	02:03.19
02:50.20	02:51.03	00:00.83	0	28	03:37.21	03:38.04	00:00.83	0	29	03:53.01
02:17.14	02:17.22	00:00.08	0	28	02:50.18	02:52.16	00:01.98	0	29	02:58.15
03:59.25	04:00.23	00:00.98	0	28	04:40.12	04:41.03	00:00.91	0	29	04:53.17
01:47.12	01:47.20	00:00.08	0	28	02:15.05	02:15.13	00:00.08	0	29	02:24.12
06:04.28	06:09.27	00:04.99	0	28	08:55.25	08:56.04	00:00.79	0	29	09:14.08
01:30.29	01:31.19	00:00.90	0	28	01:48.02	01:48.18	00:00.16	0	29	01:54.27
04:08.19	04:09.26	00:01.07	0	28	04:27.05	04:29.03	00:01.98	0	29	04:56.19
01:51.20	01:52.08	00:00.88	0	28	02:10.09	02:10.17	00:00.08	0	29	02:17.02
01:43.25	01:44.19	00:00.94	0	28	02:07.26	02:08.16	00:00.90	0	29	02:16.28
03:19.08	03:21.13	00:02.05	0	28	03:46.12	03:46.22	00:00.10	0	29	03:52.19
02:01.13	02:02.28	00:01.15	1	28	02:29.11	02:33.03	00:03.92	0	29	02:46.17
02:35.18	02:36.07	00:00.89	0	28	03:02.05	03:02.21	00:00.16	0	29	03:14.01
03:21.05	03:22.29	00:01.24	0	28	04:04.28	04:05.25	00:00.97	0	29	04:21.09
01:46.28	01:47.13	00:00.85	0	28	02:07.12	02:07.21	00:00.09	0	29	02:15.27
02:22.15	02:23.16	00:01.01	0	28	02:48.22	02:50.20	00:01.98	0	29	02:58.28
01:34.16	01:35.05	00:00.89	0	28	01:52.24	01:53.09	00:00.85	0	29	01:58.19
03:01.08	03:02.22	00:01.14	0	28	03:35.11	03:38.19	00:03.08	0	29	03:56.00

Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time
03:31.20	00:00.20	0	30	03:45.12	03:46.09	00:00.97	0	31	04:15.03	04:15.21
02:54.09	00:00.88	0	30	03:07.16	03:08.00	00:00.84	0	31	03:49.05	03:50.03
03:14.22	00:00.22	0	30	03:28.16	03:29.17	00:01.01	0	31	03:54.15	03:54.28
04:05.18	00:00.15	0	30	04:18.04	04:18.29	00:00.25	0	31	04:55.13	04:56.03
02:46.11	00:02.89	0	30	03:05.19	03:07.29	00:02.10	0	31	03:30.18	03:31.24
02:34.11	00:02.08	0	30	02:46.02	02:47.09	00:01.07	0	31	03:27.27	03:30.06
03:30.11	00:00.85	0	30	03:47.07	03:47.21	00:00.14	0	31	05:05.00	05:05.15
02:16.02	00:00.95	0	30	02:27.07	02:27.25	00:00.18	0	31	02:52.22	02:53.17
02:30.22	00:02.02	0	30	02:45.02	02:45.20	00:00.18	0	31	03:08.25	03:09.15
03:32.22	00:00.14	0	30	03:45.20	03:46.05	00:00.85	0	31	04:22.09	04:22.23
02:32.02	00:00.90	0	30	02:41.25	02:42.10	00:00.85	0	31	03:17.09	03:18.07
05:25.11	00:00.85	0	30	06:32.13	06:34.17	00:02.04	0	31	06:57.21	06:58.00
02:34.06	00:01.81	0	30	02:46.15	02:47.01	00:00.86	0	31	03:14.04	03:14.11
02:04.10	00:00.91	0	30	02:15.15	02:16.14	00:00.99	0	31	02:36.19	02:38.00
03:53.10	00:00.09	0	30	04:27.17	04:27.23	00:00.06	0	31	05:06.00	05:06.03
02:58.23	00:00.08	0	30	03:23.12	03:23.20	00:00.08	0	31	03:44.16	03:45.13
04:54.11	00:00.94	0	30	05:31.20	05:33.04	00:01.84	0	31	06:20.25	06:21.12
02:24.27	00:00.15	0	30	02:36.12	02:36.27	00:00.15	0	31	03:07.23	03:08.04
09:14.26	00:00.18	0	30	09:27.20	**00:00.00**	**00:00.00**	1	31	00:59.08	00:59.13
01:55.21	00:00.94	0	30	02:06.24	02:06.29	00:00.05	0	31	02:43.00	02:43.20
04:57.07	00:00.88	0	30	05:07.11	05:08.14	00:01.03	0	31	05:26.19	05:27.00
02:17.13	00:00.11	0	30	02:28.17	02:29.06	00:00.89	0	31	02:53.13	02:53.23
02:17.11	00:00.83	0	30	03:02.14	03:03.05	00:00.91	0	31	03:28.13	03:29.07
03:53.06	00:00.87	0	30	04:02.22	04:04.28	00:02.06	0	31	04:29.10	04:29.27
02:48.21	00:02.04	0	30	03:02.19	03:04.15	00:01.96	0	31	03:28.10	03:29.02
03:14.28	00:00.27	0	30	03:29.19	03:30.16	00:00.97	0	31	inaudible	**00:00.00**
04:21.26	00:00.17	0	30	05:04.19	05:05.08	00:00.89	0	31	05:55.05	05:55.24
02:16.05	00:00.78	0	30	02:33.24	02:34.26	00:01.02	0	31	02:57.08	02:57.24
02:59.14	00:00.86	0	30	03:10.17	03:11.26	00:01.09	0	31	**03:47.12**	**00:00.00**
01:59.03	00:00.84	0	30	02:12.06	02:13.04	00:00.98	0	31	02:35.28	02:36.09
03:58.23	00:02.23	0	30	04:26.18	04:29.12	00:02.94	0	31	05:18.05	05:18.29

RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT
00:00.18	0	32	04:24.11	04:25.06	00:00.95	0	33	04:33.28	04:34.18	00:00.90
00:00.98	0	32	04:03.10	04:04.10	00:01.00	1	33	04:20.11	04:21.18	00:01.07
00:00.13	0	32	04:06.06	04:06.29	00:00.23	1	33	04:17.20	04:18.15	00:00.95
00:00.90	1	32	05:06.24	05:07.24	00:01.00	0	33	05:18.07	05:18.23	00:00.16
00:01.06	0	32	03:54.16	03:55.07	00:00.91	1	33	04:01.25	04:02.26	00:01.01
00:02.79	0	32	03:41.09	03:42.07	00:00.98	0	33	03:57.16	03:58.15	00:00.99
00:00.15	0	32	05:25.26	05:27.23	00:01.97	0	33	07:09.20	07:10.02	00:00.82
00:00.95	0	32	03:01.12	03:02.26	00:01.14	0	33	03:09.28	03:10.26	00:00.98
00:00.90	0	32	03:18.15	03:19.22	00:01.07	0	33	03:28.08	03:28.24	00:00.16
00:00.14	0	32	04:33.12	04:34.01	00:00.89	0	33	04:58.29	04:59.19	00:00.90
00:00.98	1	32	03:27.16	03:28.27	00:01.11	1	33	03:36.20	03:39.14	00:02.94
00:00.79	1	32	07:25.14	07:26.05	00:00.91	0	33	08:08.17	08:09.05	00:00.88
00:00.07	0	32	03:22.15	03:22.25	00:00.10	1	33	03:29.22	03:30.03	00:00.81
00:01.81	0	32	02:44.28	02:45.27	00:00.99	1	33	02:52.14	02:53.08	00:00.94
00:00.03	0	32	05:30.00	05:31.16	00:01.16	0	33	05:45.03	05:46.08	00:01.05
00:00.97	0	32	03:56.06	03:57.16	00:01.10	0	33	04:06.26	04:07.13	00:00.87
00:00.87	1	32	06:28.19	06:29.02	00:00.83	0	33	07:59.19	08:00.01	00:00.82
00:00.81	0	32	03:16.27	03:17.10	00:00.83	0	33	03:24.23	03:25.07	00:00.84
00:00.05	0	32	01:53.20	01:54.15	00:00.95	1	33	02:52.04	02:52.18	00:00.14
00:00.20	1	32	02:51.27	02:53.01	00:01.74	0	33	02:59.11	02:59.18	00:00.07
00:00.81	0	32	05:37.15	05:40.09	00:02.94	0	33	06:00.19	06:02.11	00:01.92
00:00.10	0	32	03:02.17	03:03.09	00:00.92	0	33	03:15.21	03:16.26	00:01.05
00:00.94	0	32	03:40.26	03:41.17	00:00.91	1	33	03:49.28	03:50.20	00:00.92
00:00.17	0	32	04:36.02	04:36.13	00:00.11	0	33	04:43.11	04:44.02	00:00.91
00:00.92	0	32	03:41.29	03:44.06	00:02.77	0	33	03:52.13	03:52.29	00:00.16
00:00.00	0	32	04:24.08	04:25.01	00:00.93	0	33	04:35.13	04:35.27	00:00.14
00:00.19	0	32	06:08.03	06:09.13	00:01.10	0	33	06:20.23	06:21.16	00:00.93
00:00.16	0	32	03:08.01	03:08.17	00:00.16	0	33	03:15.14	03:16.00	00:00.86
00:00.00	0	32	03:57.17	03:58.28	00:01.11	1	33	04:28.10	04:29.10	00:01.00
00:00.81	0	32	02:44.09	02:44.17	00:00.08	0	33	02:50.21	02:51.09	00:00.88
00:00.24	0	32	05:33.21	05:34.18	00:00.97	0	33	05:45.28	05:47.03	00:01.75

Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring
0	34	04:43.12	04:44.05	00:00.93	0	35	04:54.08	04:54.29	00:00.21	0
0	34	04:30.19	04:32.19	00:02.00	0	35	04:53.24	04:54.23	00:00.99	0
0	34	04:39.04	04:40.17	00:01.13	0	35	04:59.05	05:00.01	00:00.96	0
0	34	05:31.07	05:32.25	00:01.18	1	35	05:47.12	05:48.00	00:00.88	1
0	34	04:10.27	04:13.09	00:02.82	0	35	04:23.18	04:26.05	00:02.87	0
0	34	04:09.16	04:12.24	00:03.08	0	35	04:24.12	04:25.18	00:01.06	0
0	34	08:39.28	08:41.04	00:01.76	0	35	00:37.05	00:37.24	00:00.19	0
0	34	03:19.04	03:19.25	00:00.21	0	35	03:31.07	03:32.21	00:01.14	0
0	34	03:40.25	03:41.10	00:00.85	0	35	03:56.14	03:57.05	00:00.91	0
0	34	05:09.08	05:10.08	00:01.00	0	35	05:28.26	05:29.13	00:00.87	1
0	34	03:47.09	03:49.22	00:02.13	0	35	04:00.29	04:01.12	00:00.83	0
0	34	08:50.04	08:51.10	00:01.06	0	35	00:18.00	00:18.21	00:00.21	1
0	34	03:38.28	03:39.24	00:00.96	0	35	04:01.08	04:02.21	00:01.13	0
0	34	03:07.00	03:08.12	00:01.12	0	35	03:20.13	03:21.00	00:00.87	0
0	34	06:02.01	06:02.13	00:00.12	0	35	06:27.14	06:27.28	00:00.14	1
0	34	04:16.28	04:18.13	00:01.85	1	35	04:34.28	04:36.00	00:01.72	1
0	34	08:29.05	08:29.28	00:00.23	1	35	08:55.00	08:55.22	00:00.22	0
0	34	03:34.23	03:35.02	00:00.79	0	35	03:48.10	03:49.18	00:01.08	**0**
0	34	03:01.21	03:02.22	00:01.01	0	35	03:45.29	03:46.19	00:00.90	1
0	34	03:07.04	03:07.17	00:00.13	0	35	03:19.14	03:20.01	00:00.87	0
0	34	07:49.01	07:49.28	00:00.27	0	35	08:03.08	08:03.18	00:00.10	0
0	34	03:25.29	03:26.16	00:00.87	0	35	03:50.15	03:51.04	00:00.89	0
0	34	04:58.07	04:59.06	00:00.99	1	35	05:35.23	05:36.08	00:00.85	1
0	34	04:51.04	04:52.28	00:01.24	0	35	05:18.26	05:19.11	00:00.85	0
0	34	04:04.04	04:04.28	00:00.24	0	35	04:18.26	04:20.25	00:01.99	1
0	34	04:47.22	04:48.13	00:00.91	0	35	inaudible	**00:00.00**	**00:00.00**	0
0	34	06:41.11	06:42.17	00:01.06	0	35	06:55.21	06:56.18	00:00.97	1
0	34	03:25.10	03:26.01	00:00.91	0	35	03:38.16	03:39.00	00:00.84	1
0	34	04:42.20	04:44.15	00:01.95	1	35	05:01.17	05:02.03	00:00.86	0
0	34	03:01.05	03:01.22	00:00.17	0	35	03:15.04	03:15.14	00:00.10	0
0	34	06:06.03	06:09.01	00:02.98	0	35	06:26.13	06:26.26	00:00.13	0

Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #
36	05:02.00	05:02.28	00:00.28	0	37	05:25.01	05:26.00	00:00.99	1	38
36	05:03.16	05:04.20	00:01.04	0	37	05:22.01	05:22.28	00:00.27	1	38
36	05:21.03	05:21.23	00:00.20	0	37	05:45.03	05:45.20	00:00.17	1	38
36	06:28.24	06:29.09	00:00.85	0	37	06:40.05	06:40.22	00:00.17	1	38
36	04:34.07	04:34.28	00:00.21	0	37	04:44.18	04:45.07	00:00.89	1	38
36	04:35.27	04:36.23	00:00.96	0	37	04:48.00	04:49.04	00:01.04	1	38
36	07:33.26	07:35.19	00:01.93	0	37	08:32.05	08:32.19	00:00.14	1	38
36	03:38.25	03:39.19	00:00.94	0	37	03:54.20	03:55.16	00:00.96	0	38
36	04:04.15	04:05.08	00:00.93	0	37	04:15.05	04:15.19	00:00.14	1	38
36	05:38.11	05:39.15	00:01.04	0	37	05:56.19	05:57.02	00:00.83	1	38
36	04:24.28	04:28.02	00:03.74	0	37	04:41.13	04:42.00	00:00.87	1	38
36	01:56.07	01:56.22	00:00.15	0	37	03:08.27	03:09.13	00:00.86	1	38
36	04:11.08	04:12.00	00:00.92	0	37	**04:22.25**	**00:00.00**	**00:00.00**	1	38
36	03:29.14	03:30.01	00:00.87	0	37	03:42.03	03:42.21	00:00.18	1	38
36	06:54.11	06:54.20	00:00.09	0	37	07:15.06	07:15.19	00:00.13	0	38
36	04:45.20	04:48.21	00:03.01	0	37	05:05.21	05:05.28	00:00.07	1	38
36	09:18.28	09:19.07	00:00.79	0	37	00:14.25	00:16.03	00:01.78	1	38
36	03:56.14	03:56.25	00:00.11	0	37	04:09.22	04:10.12	00:00.90	1	38
36	06:55.28	06:56.04	00:00.76	0	37	07:20.02	07:19.27	-00:00.75	0	38
36	03:29.10	03:29.17	00:00.07	0	37	03:38.28	03:39.10	00:00.82	1	38
36	08:12.25	08:13.21	00:00.96	0	37	08:24.27	08:25.10	00:00.83	1	38
36	04:06.01	04:06.19	00:00.18	0	37	04:19.08	04:19.18	00:00.10	1	38
36	06:07.10	06:07.29	00:00.19	0	37	06:19.12	06:20.05	00:00.93	0	38
36	05:54.14	05:55.08	00:00.94	0	37	06:17.02	06:17.29	00:00.27	1	38
36	04:31.15	04:34.02	00:02.87	0	37	04:52.20	04:54.18	00:01.98	0	38
36	05:15.08	05:16.12	00:01.04	0	37	05:28.09	05:28.20	00:00.11	1	38
36	07:07.26	07:08.28	00:01.02	0	37	07:45.20	07:46.02	00:00.82	1	38
36	03:54.16	03:54.21	00:00.05	0	37	04:06.01	04:06.13	00:00.12	1	38
36	05:21.25	05:23.13	00:01.88	0	37	05:36.13	05:37.20	00:01.07	1	38
36	03:25.01	03:25.11	00:00.10	0	37	03:34.02	03:34.17	00:00.15	1	38
36	06:38.10	06:40.12	00:02.02	0	37	06:55.18	06:56.05	00:00.87	1	38

Cue Time	Reaction time	RT	Scoring	Item #	Cue Time	Reaction time	RT	Scoring	Item #	Cue Time
05:30.21	05:31.14	00:00.93	1	39	05:38.09	05:39.19	00:01.10	0	40	05:56.21
05:32.14	05:32.29	00:00.15	1	39	05:49.24	05:51.04	00:01.80	0	40	06:26.19
05:57.26	05:58.22	00:00.96	1	39	06:06.23	06:07.11	00:00.88	0	40	06:21.05
07:09.11	07:09.28	00:00.17	1	39	07:21.29	07:23.05	00:01.76	1	40	07:41.21
04:53.07	04:53.25	00:00.18	1	39	05:02.01	05:04.06	00:02.05	0	40	05:14.29
04:57.00	04:58.20	00:01.20	1	39	05:06.18	05:07.20	00:01.02	1	40	05:21.11
00:04.04	00:04.28	00:00.24	1	39	00:17.22	00:18.11	00:00.89	1	40	07:57.27
04:02.12	04:02.29	00:00.17	1	39	04:12.03	04:12.26	00:00.23	0	40	04:26.24
04:24.27	04:25.16	00:00.89	1	39	04:35.18	04:37.22	00:02.04	0	40	04:53.17
06:07.18	06:08.03	00:00.85	1	39	06:21.13	06:21.28	00:00.15	0	40	06:37.25
04:50.15	04:51.00	00:00.85	1	39	05:01.26	05:03.15	00:01.89	0	40	05:18.14
03:15.25	03:16.04	00:00.79	1	39	03:52.07	03:53.00	00:00.93	0	40	04:15.07
04:30.21	04:31.01	00:00.80	1	39	04:39.18	04:40.07	00:00.89	1	40	04:52.28
03:50.02	03:50.17	00:00.15	1	39	03:58.08	03:58.29	00:00.21	0	40	04:14.08
07:28.04	07:28.12	00:00.08	1	39	07:41.17	07:41.26	00:00.09	0	40	09:19.15
05:13.28	05:14.08	00:00.80	1	39	05:24.00	05:24.15	00:00.15	0	40	05:40.12
00:25.23	00:26.12	00:00.89	1	39	01:20.05	01:21.22	00:01.17	0	40	02:19.07
04:16.26	04:17.07	00:00.81	1	39	04:27.04	04:27.14	00:00.10	0	40	04:43.18
07:30.28	07:31.06	00:00.78	0	39	07:41.21	07:42.25	00:01.04	0	40	08:16.25
03:48.20	03:49.24	00:01.04	1	39	04:01.07	04:01.22	00:00.15	0	40	04:16.05
08:59.18	09:00.03	00:00.85	1	39	00:00.09	00:00.21	00:00.12	0	40	00:19.25
04:32.14	04:32.16	00:00.02	1	39	04:42.02	04:42.16	00:00.14	0	40	04:59.20
06:37.00	06:37.20	00:00.20	1	39	08:24.24	08:25.05	00:00.81	0	40	08:54.28
06:25.14	06:25.25	00:00.11	1	39	06:33.27	06:34.06	00:00.79	0	40	07:29.17
05:05.21	05:07.00	00:01.79	1	39	05:19.06	05:20.03	00:00.97	0	40	05:35.19
05:40.00	05:40.07	00:00.07	1	39	05:49.28	05:50.14	00:00.86	0	40	06:16.02
07:56.20	07:57.27	00:01.07	0	39	08:25.15	08:26.10	00:00.95	0	40	09:05.09
04:14.21	04:14.28	00:00.07	1	39	04:23.22	04:24.07	00:00.85	1	40	04:27.03
06:07.24	06:08.19	00:00.95	1	39	06:22.15	06:25.08	00:02.93	0	40	06:40.00
03:42.24	03:43.08	00:00.84	1	39	03:51.07	03:51.20	00:00.13	0	40	04:02.16
07:09.27	07:10.14	00:00.87	1	39	07:24.06	07:24.26	00:00.20	0	40	07:41.03

Reaction time	RT	Scoring	Block 1 RT	Block 1 (sec)	Block 1 Accuracy	Block 2 RT	Block 2 (sec)
05:57.18	00:00.97	0	00:01.99	1.99	0.3	00:01.45	1.45
06:27.14	00:00.95	0	**00:01.49**	**1.49**	0.1	00:01.32	1.32
06:22.17	00:01.12	1	**00:01.09**	**1.09**	0.3	00:00.50	0.5
07:42.14	00:00.93	0	00:01.31	1.31	0.2	00:01.01	1.01
05:16.01	00:01.72	0	00:01.54	1.54	0.3	**00:01.11**	**1.11**
05:22.27	00:01.16	0	00:02.01	2.01	0.2	00:01.79	1.79
07:58.29	00:01.02	0	00:01.39	1.39	0.3	00:00.91	0.91
04:28.09	00:01.85	0	00:01.97	1.97	0.3	00:01.61	1.61
04:55.02	00:01.85	0	00:02.40	2.4	0.3	00:02.06	2.06
06:38.22	00:00.97	0	00:01.19	1.19	0.2	00:00.90	0.9
05:19.12	00:00.98	0	**00:02.62**	**2.62**	0.1	00:01.79	1.79
04:16.18	00:01.11	0	00:01.07	1.07	0.2	00:00.63	0.63
04:53.20	00:00.92	0	00:01.49	1.49	0.2	00:01.36	1.36
04:15.04	00:00.96	1	00:01.74	1.74	0.2	00:01.29	1.29
09:20.01	00:00.86	0	00:00.23	0.23	0	**00:00.53**	**0.53**
05:42.19	00:02.07	0	00:02.15	2.15	0.3	00:01.45	1.45
02:19.20	00:00.13	1	**00:00.88**	**0.88**	0.3	00:00.94	0.94
04:44.00	00:00.82	0	00:01.00	1	0.3	00:01.16	1.16
08:17.03	00:00.78	0	**00:01.77**	**1.77**	0.3	00:01.05	1.05
04:16.14	00:00.09	0	00:01.69	1.69	0.2	00:02.24	2.24
00:20.23	00:00.98	0	00:01.31	1.31	0.2	00:00.81	0.81
05:00.06	00:00.86	0	00:01.14	1.14	0.4	00:00.69	0.69
08:55.19	00:00.91	0	00:00.76	0.76	0.3	00:01.00	1
07:30.13	00:00.96	0	00:01.85	1.85	0.2	00:01.47	1.47
05:37.01	00:01.82	0	00:01.38	1.38	0.2	00:01.20	1.2
06:17.02	00:01.00	0	00:01.74	1.74	0.3	00:01.27	1.27
09:06.06	00:00.97	0	00:00.90	0.9	0.2	00:01.22	1.22
04:37.21	00:10.18	0	00:01.00	1	0.3	00:00.97	0.97
06:40.29	00:00.29	1	00:02.16	2.16	0.2	00:01.71	1.71
04:03.08	00:00.92	0	00:00.65	0.65	0.3	00:00.42	0.42
07:41.24	00:00.21	0	00:01.49	1.49	0.3	00:01.51	1.51

Block 2 Accuracy	Block 3 RT	Block 3 (sec)	Block 3 Accuracy	Block 4 RT	Block 4 (sec)	Block 4 Accuracy
0.3	00:01.08	1.08	0.1	00:00.74	0.74	0.2
0.3	00:01.11	1.11	0.2	00:01.03	1.03	0.3
0.3	00:00.73	0.73	0.2	00:00.67	0.67	0.4
0.2	00:00.46	0.46	0.2	00:00.80	0.8	0.6
0.5	00:01.44	1.44	0.1	00:01.37	1.37	0.3
0.4	00:01.70	1.7	0	00:01.43	1.43	0.3
0.3	00:00.79	0.79	0.2	00:00.91	0.91	0.3
0.3	00:01.04	1.04	0.1	00:00.86	0.86	0.1
0.3	00:00.68	0.68	0.2	00:00.97	0.97	0.2
0.3	00:00.60	0.68	0.1	00:00.76	0.76	0.3
0.5	00:01.17	1.17	0.1	00:01.63	1.63	0.4
0.3	00:00.89	0.89	0.2	00:00.77	0.77	0.4
0.2	00:00.78	0.78	0.1	**00:00.73**	**0.73**	0.4
0.2	00:00.91	0.91	0.2	00:00.81	0.81	0.4
0.2	**00:00.33**	**0.33**	0	00:00.38	0.38	0.2
0.2	00:00.59	0.59	0.1	00:01.26	1.26	0.4
0.4	00:00.77	0.77	0.1	00:00.77	0.77	0.5
0.4	00:00.26	0.26	0.1	00:00.71	0.71	**0.222222222**
0.2	**00:01.13**	**1.13**	0.3	00:00.57	0.57	0.2
0.4	00:00.52	0.52	0.2	00:00.52	0.52	0.3
0.4	00:01.06	1.06	0.2	00:00.98	0.98	0.2
0.2	00:00.56	0.56	0.2	00:00.51	0.51	0.2
0.3	00:00.60	0.6	0.2	00:00.76	0.76	0.4
0.2	00:00.97	0.97	0.1	00:00.63	0.63	0.2
0.2	00:01.52	1.52	0.3	00:01.55	1.55	0.2
0.4	**00:00.59**	**0.59**	0.1	00:00.63	0.63	0.2
0.3	00:00.91	0.91	0.1	00:00.91	0.91	0.2
0.3	00:00.73	0.73	0.2	00:01.42	1.42	0.4
0.3	00:01.20	1.2	0.1	**00:01.34**	**1.34**	0.5
0.4	00:00.76	0.76	0.1	00:00.42	0.42	0.2
0.3	00:01.50	1.5	0.1	00:01.02	1.02	0.2

APPENDIX C

TLX DATA

Scale	Value	Weight
Subject 4		
SWAN single task		
Mental Demand	15	0.2
Physical Demand	15	0
Temporal Demand	15	0.2
Performance	10	0.266667
Effort	15	0.0666667
Frustration	20	0.266667
Total Workload	15	
Speech discrimination single task		
Mental Demand	85	0.333333
Physical Demand	5	0
Temporal Demand	70	0.0666667
Performance	55	0.133333
Effort	80	0.2
Frustration	70	0.266667
Total Workload	75	
Dual task		
Mental Demand	90	0.333333
Physical Demand	75	0
Temporal Demand	80	0.133333
Performance	70	0.0666667
Effort	80	0.2
Frustration	80	0.266667
Total Workload	82.6667	
Subject 5		
SWAN single task		
Mental Demand	75	0.266667
Physical Demand	25	0
Temporal Demand	75	0.2
Performance	20	0.133333
Effort	25	0.333333
Frustration	35	0.0666667

Total Workload	48.3333	
Speech discrimination single task		
Mental Demand	85	0.2
Physical Demand	35	0
Temporal Demand	80	0.266667
Performance	85	0.133333
Effort	90	0.0666667
Frustration	90	0.333333
Total Workload	85.6667	
Dual task		
Mental Demand	80	0.333333
Physical Demand	80	0.133333
Temporal Demand	75	0.133333
Performance	90	0.2
Effort	100	0.0666667
Frustration	85	0.133333
Total Workload	83.3333	
Subject 6		
SWAN single task		
Mental Demand	25	0.2
Physical Demand	15	0.133333
Temporal Demand	15	0
Performance	30	0.333333
Effort	35	0.2
Frustration	10	0.133333
Total Workload	25.3333	
Speech discrimination single task		
Mental Demand	25	0.266667
Physical Demand	20	0
Temporal Demand	20	0.0666667
Performance	40	0.266667
Effort	40	0.133333
Frustration	50	0.266667
Total Workload	37.3333	
Dual task		
Mental Demand	35	0.333333

Physical Demand	20	0
Temporal Demand	25	0.0666667
Performance	30	0.266667
Effort	30	0.133333
Frustration	30	0.2
Total Workload	31.3333	
Subject 7		
SWAN single task		
Mental Demand	30	0.333333
Physical Demand	15	0
Temporal Demand	25	0.133333
Performance	5	0.2
Effort	20	0.266667
Frustration	20	0.0666667
Total Workload	21	
Speech discrimination single task		
Mental Demand	60	0.266667
Physical Demand	10	0
Temporal Demand	20	0.0666667
Performance	65	0.133333
Effort	70	0.333333
Frustration	75	0.2
Total Workload	64.3333	
Dual task		
Mental Demand	75	0.333333
Physical Demand	15	0
Temporal Demand	30	0.0666667
Performance	45	0.2
Effort	70	0.2
Frustration	55	0.2
Total Workload	61	
Subject 9		
SWAN single task		
Mental Demand	40	0.266667
Physical Demand	15	0.0666667
Temporal Demand	40	0.2
Performance	65	0.333333
Effort	25	0.133333
Frustration	20	0

Total Workload	44.6667	
Speech discrimination single task		
Mental Demand	85	0.333333
Physical Demand	10	0
Temporal Demand	10	0.0666667
Performance	25	0.2
Effort	80	0.133333
Frustration	70	0.266667
Total Workload	63.3333	
Dual task		
Mental Demand	95	0.333333
Physical Demand	25	0
Temporal Demand	50	0.0666667
Performance	75	0.133333
Effort	80	0.2
Frustration	90	0.266667
Total Workload	85	
Subject 10		
SWAN single task		
Mental Demand	5	0.0666667
Physical Demand	10	0
Temporal Demand	25	0.333333
Performance	40	0.266667
Effort	30	0.133333
Frustration	45	0.2
Total Workload	32.3333	
Speech discrimination single task		
Mental Demand	20	0.133333
Physical Demand	5	0
Temporal Demand	20	0.2
Performance	50	0.333333
Effort	25	0.266667
Frustration	10	0.0666667
Total Workload	30.6667	
Dual task		
Mental Demand	30	0.0666667

Physical Demand	5	0
Temporal Demand	50	0.2
Performance	35	0.266667
Effort	55	0.133333
Frustration	70	0.333333
Total Workload	52	
Subject 11		
SWAN single task		
Mental Demand	85	0.266667
Physical Demand	55	0.133333
Temporal Demand	55	0.266667
Performance	25	0.0666667
Effort	35	0.266667
Frustration	10	0
Total Workload	55.6667	
Speech discrimination single task		
Mental Demand	90	0.333333
Physical Demand	65	0.0666667
Temporal Demand	85	0.266667
Performance	70	0
Effort	100	0.2
Frustration	55	0.133333
Total Workload	84.3333	
Dual task		
Mental Demand	100	0.333333
Physical Demand	80	0.2
Temporal Demand	100	0.266667
Performance	65	0
Effort	100	0.133333
Frustration	60	0.0666667
Total Workload	93.3333	
Subject 12		
SWAN single task		
Mental Demand	65	0.2
Physical Demand	5	0.0666667
Temporal Demand	70	0.133333
Performance	15	0.333333
Effort	80	0.266667
Frustration	15	0

Total Workload	49	
Speech discrimination single task		
Mental Demand	95	0.266667
Physical Demand	5	0
Temporal Demand	100	0.266667
Performance	70	0.0666667
Effort	95	0.133333
Frustration	70	0.266667
Total Workload	88	
Dual task		
Mental Demand	95	0.333333
Physical Demand	35	0
Temporal Demand	90	0.133333
Performance	40	0.2
Effort	85	0.2
Frustration	80	0.133333
Total Workload	79.3333	
Subject 13		
SWAN single task		
Mental Demand	60	0.133333
Physical Demand	50	0.0666667
Temporal Demand	55	0.2
Performance	40	0.2
Effort	60	0.133333
Frustration	65	0.266667
Total Workload	55.6667	
Speech discrimination single task		
Mental Demand	85	0.333333
Physical Demand	30	0.0666667
Temporal Demand	10	0
Performance	70	0.133333
Effort	75	0.266667
Frustration	75	0.2
Total Workload	74.6667	
Dual task		
Mental Demand	85	0.266667

Physical Demand	50	0
Temporal Demand	45	0.0666667
Performance	65	0.133333
Effort	80	0.333333
Frustration	70	0.2
Total Workload	75	
Subject 14		
SWAN single task		
Mental Demand	30	0.266667
Physical Demand	15	0
Temporal Demand	20	0.133333
Performance	20	0.333333
Effort	45	0.2
Frustration	10	0.0666667
Total Workload	27	
Speech discrimination single task		
Mental Demand	85	0.266667
Physical Demand	5	0
Temporal Demand	75	0.2
Performance	85	0.266667
Effort	85	0.0666667
Frustration	75	0.2
Total Workload	81	
Dual task		
Mental Demand	90	0.2
Physical Demand	10	0.0666667
Temporal Demand	60	0.333333
Performance	65	0.266667
Effort	85	0.0666667
Frustration	55	0.0666667
Total Workload	65.3333	
Subject 15		
SWAN single task		
Mental Demand	20	0.0666667
Physical Demand	15	0
Temporal Demand	50	0.266667
Performance	50	0.333333
Effort	65	0.133333
Frustration	55	0.2

Total Workload	51	
Speech discrimination single task		
Mental Demand	50	0.2
Physical Demand	5	0
Temporal Demand	5	0.0666667
Performance	5	0.333333
Effort	50	0.266667
Frustration	55	0.133333
Total Workload	32.6667	
Dual task		
Mental Demand	60	0.2
Physical Demand	45	0.0666667
Temporal Demand	70	0.0666667
Performance	5	0.333333
Effort	50	0.266667
Frustration	35	0.0666667
Total Workload	37	
Subject 16		
SWAN single task		
Mental Demand	50	0.266667
Physical Demand	40	0
Temporal Demand	35	0.266667
Performance	20	0.133333
Effort	15	0.266667
Frustration	5	0.0666667
Total Workload	29.6667	
Speech discrimination single task		
Mental Demand	10	0.266667
Physical Demand	10	0
Temporal Demand	10	0.333333
Performance	25	0.2
Effort	30	0.133333
Frustration	15	0.0666667
Total Workload	16	
Dual task		
Mental Demand	10	0.333333

Physical Demand	10	0.133333
Temporal Demand	10	0.133333
Performance	25	0.2
Effort	15	0.133333
Frustration	10	0.0666667
Total Workload	13.6667	
Subject 17		
SWAN single task		
Mental Demand	15	0.2
Physical Demand	15	0.0666667
Temporal Demand	30	0.333333
Performance	15	0.133333
Effort	20	0.266667
Frustration	10	0
Total Workload	21.3333	
Speech discrimination single task		
Mental Demand	65	0.333333
Physical Demand	10	0
Temporal Demand	50	0.266667
Performance	50	0.133333
Effort	40	0.0666667
Frustration	50	0.2
Total Workload	54.3333	
Dual task		
Mental Demand	70	0.333333
Physical Demand	25	0
Temporal Demand	65	0.266667
Performance	55	0.2
Effort	45	0.133333
Frustration	45	0.0666667
Total Workload	60.6667	
Subject 18		
SWAN single task		
Mental Demand	45	0.266667
Physical Demand	15	0.0666667
Temporal Demand	35	0.133333
Performance	70	0.333333
Effort	80	0.2
Frustration	20	0

Total Workload	57	
Speech discrimination single task		
Mental Demand	90	0.333333
Physical Demand	5	0
Temporal Demand	75	0.133333
Performance	75	0.2
Effort	80	0.266667
Frustration	65	0.0666667
Total Workload	80.6667	
Dual task		
Mental Demand	95	0.333333
Physical Demand	30	0
Temporal Demand	70	0.133333
Performance	50	0.2
Effort	95	0.266667
Frustration	60	0.0666667
Total Workload	80.3333	
Subject 20		
SWAN single task		
Mental Demand	25	0.333333
Physical Demand	10	0
Temporal Demand	15	0.133333
Performance	20	0.2
Effort	25	0.0666667
Frustration	25	0.266667
Total Workload	22.6667	
Speech discrimination single task		
Mental Demand	55	0.333333
Physical Demand	20	0.0666667
Temporal Demand	15	0.133333
Performance	35	0.2
Effort	55	0.266667
Frustration	25	0
Total Workload	43.3333	
Dual task		
Mental Demand	50	0.333333

Physical Demand	20	0
Temporal Demand	20	0.266667
Performance	45	0.133333
Effort	55	0.2
Frustration	50	0.0666667
Total Workload	42.3333	
Subject 21		
SWAN single task		
Mental Demand	70	0.266667
Physical Demand	60	0.0666667
Temporal Demand	65	0.2
Performance	70	0.133333
Effort	65	0.333333
Frustration	25	0
Total Workload	66.6667	
Speech discrimination single task		
Mental Demand	95	0.333333
Physical Demand	15	0
Temporal Demand	80	0.2
Performance	80	0.0666667
Effort	95	0.2
Frustration	95	0.2
Total Workload	91	
Dual task		
Mental Demand	95	0.266667
Physical Demand	95	0.133333
Temporal Demand	95	0.133333
Performance	90	0
Effort	95	0.133333
Frustration	100	0.333333
Total Workload	96.6667	
Subject 22		
SWAN single task		
Mental Demand	75	0.333333
Physical Demand	25	0
Temporal Demand	75	0.2
Performance	70	0.266667
Effort	65	0.133333
Frustration	70	0.0666667

Total Workload	72	
Speech discrimination single task		
Mental Demand	90	0.266667
Physical Demand	10	0
Temporal Demand	75	0.266667
Performance	75	0.0666667
Effort	70	0.2
Frustration	75	0.2
Total Workload	78	
Dual task		
Mental Demand	90	0.333333
Physical Demand	15	0.0666667
Temporal Demand	90	0.2
Performance	75	0.266667
Effort	80	0.133333
Frustration	70	0
Total Workload	79.6667	
Subject 23		
SWAN single task		
Mental Demand	50	0.266667
Physical Demand	35	0.0666667
Temporal Demand	40	0.2
Performance	20	0.133333
Effort	35	0.333333
Frustration	25	0
Total Workload	38	
Speech discrimination single task		
Mental Demand	95	0.333333
Physical Demand	15	0.0666667
Temporal Demand	50	0.2
Performance	60	0.133333
Effort	100	0.266667
Frustration	95	0
Total Workload	77.3333	
Dual task		
Mental Demand	100	0.266667

Physical Demand	100	0.2
Temporal Demand	90	0.133333
Performance	45	0.0666667
Effort	100	0.333333
Frustration	100	0
Total Workload	95	
Subject 24		
SWAN single task		
Mental Demand	15	0.133333
Physical Demand	25	0.0666667
Temporal Demand	50	0.266667
Performance	30	0.133333
Effort	15	0.0666667
Frustration	15	0.333333
Total Workload	27	
Speech discrimination single task		
Mental Demand	85	0.333333
Physical Demand	30	0
Temporal Demand	15	0.0666667
Performance	55	0.133333
Effort	75	0.2
Frustration	75	0.266667
Total Workload	71.6667	
Dual task		
Mental Demand	80	0.266667
Physical Demand	25	0
Temporal Demand	60	0.133333
Performance	45	0.0666667
Effort	60	0.333333
Frustration	55	0.2
Total Workload	63.3333	
Subject 25		
SWAN single task		
Mental Demand	50	0.2
Physical Demand	10	0
Temporal Demand	75	0.333333
Performance	60	0.266667
Effort	35	0.0666667
Frustration	35	0.133333

Total Workload	58	
Speech discrimination single task		
Mental Demand	85	0.266667
Physical Demand	10	0
Temporal Demand	90	0.333333
Performance	95	0.0666667
Effort	65	0.133333
Frustration	85	0.2
Total Workload	84.6667	
Dual task		
Mental Demand	90	0.333333
Physical Demand	15	0
Temporal Demand	90	0.266667
Performance	100	0.133333
Effort	85	0.0666667
Frustration	95	0.2
Total Workload	92	
Subject 26		
SWAN single task		
Mental Demand	30	0.133333
Physical Demand	10	0
Temporal Demand	45	0.333333
Performance	20	0.2
Effort	20	0.266667
Frustration	20	0.0666667
Total Workload	29.6667	
Speech discrimination single task		
Mental Demand	85	0.2
Physical Demand	5	0
Temporal Demand	20	0.0666667
Performance	90	0.266667
Effort	75	0.133333
Frustration	75	0.333333
Total Workload	77.3333	
Dual task		
Mental Demand	90	0.333333

Physical Demand	20	0
Temporal Demand	35	0.133333
Performance	75	0.2
Effort	85	0.266667
Frustration	60	0.0666667
Total Workload	76.3333	
Subject 27		
SWAN single task		
Mental Demand	60	0.333333
Physical Demand	35	0.0666667
Temporal Demand	55	0.2
Performance	35	0.266667
Effort	45	0.133333
Frustration	25	0
Total Workload	48.6667	
Speech discrimination single task		
Mental Demand	80	0.333333
Physical Demand	65	0.0666667
Temporal Demand	80	0.266667
Performance	35	0
Effort	70	0.133333
Frustration	65	0.2
Total Workload	74.6667	
Dual task		
Mental Demand	85	0.333333
Physical Demand	70	0.133333
Temporal Demand	80	0.266667
Performance	40	0.0666667
Effort	80	0
Frustration	85	0.2
Total Workload	78.6667	
Subject 28		
SWAN single task		
Mental Demand	90	0.266667
Physical Demand	10	0.0666667
Temporal Demand	10	0.0666667
Performance	20	0.333333
Effort	95	0.2
Frustration	30	0.0666667

Total Workload	53	
Speech discrimination single task		
Mental Demand	95	0.266667
Physical Demand	5	0
Temporal Demand	90	0.133333
Performance	40	0.333333
Effort	95	0.2
Frustration	60	0.0666667
Total Workload	73.6667	
Dual task		
Mental Demand	100	0.333333
Physical Demand	5	0
Temporal Demand	95	0.133333
Performance	50	0.2
Effort	90	0.266667
Frustration	55	0.0666667
Total Workload	83.6667	
Subject 29		
SWAN single task		
Mental Demand	15	0.133333
Physical Demand	25	0.266667
Temporal Demand	5	0.0666667
Performance	15	0.333333
Effort	25	0.2
Frustration	5	0
Total Workload	19	
Speech discrimination single task		
Mental Demand	75	0.266667
Physical Demand	15	0
Temporal Demand	30	0.0666667
Performance	75	0.266667
Effort	80	0.266667
Frustration	50	0.133333
Total Workload	70	
Dual task		
Mental Demand	100	0.333333

Physical Demand	25	0
Temporal Demand	25	0.2
Performance	75	0.133333
Effort	90	0.266667
Frustration	60	0.0666667
Total Workload	76.3333	
Subject 30		
SWAN single task		
Mental Demand	30	0.266667
Physical Demand	10	0.0666667
Temporal Demand	15	0.133333
Performance	15	0.2
Effort	25	0.333333
Frustration	5	0
Total Workload	22	
Speech discrimination single task		
Mental Demand	45	0.333333
Physical Demand	5	0
Temporal Demand	15	0.0666667
Performance	80	0.133333
Effort	65	0.266667
Frustration	35	0.2
Total Workload	51	
Dual task		
Mental Demand	45	0.2
Physical Demand	10	0
Temporal Demand	50	0.333333
Performance	50	0.2
Effort	45	0.2
Frustration	15	0.0666667
Total Workload	45.6667	
Subject 31		
SWAN single task		
Mental Demand	55	0.333333
Physical Demand	20	0
Temporal Demand	20	0.0666667
Performance	20	0.2
Effort	50	0.266667
Frustration	25	0.133333

Total Workload	40.3333	
Speech discrimination single task		
Mental Demand	60	0.2
Physical Demand	5	0
Temporal Demand	100	0.333333
Performance	60	0.0666667
Effort	85	0.2
Frustration	65	0.2
Total Workload	79.3333	
Dual task		
Mental Demand	90	0.266667
Physical Demand	25	0
Temporal Demand	90	0.333333
Performance	70	0.0666667
Effort	85	0.2
Frustration	65	0.133333
Total Workload	84.3333	
Subject 32		
Mental Demand	30	0.333333
Physical Demand	15	0.0666667
Temporal Demand	45	0.2
Performance	25	0
Effort	40	0.266667
Frustration	15	0.133333
Total Workload	32.6667	
Speech discrimination single task		
Mental Demand	80	0.333333
Physical Demand	10	0.0666667
Temporal Demand	85	0.2
Performance	90	0
Effort	90	0.266667
Frustration	65	0.133333
Total Workload	77	
Dual task		
Mental Demand	90	0.333333
Physical Demand	20	0.0666667

Temporal Demand	95	0.2
Performance	40	0
Effort	95	0.266667
Frustration	65	0.133333
Total Workload	84.3333	
Subject 33		
SWAN single task		
Mental Demand	60	0.0666667
Physical Demand	20	0
Temporal Demand	50	0.133333
Performance	50	0.266667
Effort	40	0.2
Frustration	55	0.333333
Total Workload	50.3333	
Speech discrimination single task		
Mental Demand	75	0.133333
Physical Demand	5	0
Temporal Demand	65	0.133333
Performance	75	0.266667
Effort	70	0.2
Frustration	95	0.266667
Total Workload	78	
Dual task		
Mental Demand	65	0.133333
Physical Demand	10	0
Temporal Demand	50	0.0666667
Performance	40	0.2
Effort	60	0.266667
Frustration	65	0.333333
Total Workload	57.6667	
Subject 35		
SWAN single task		
Mental Demand	10	0.0666667
Physical Demand	15	0.2
Temporal Demand	20	0.333333
Performance	10	0.266667
Effort	10	0.133333
Frustration	5	0
Total Workload	14.3333	

Speech discrimination single task		
Mental Demand	65	0.333333
Physical Demand	10	0
Temporal Demand	45	0.133333
Performance	70	0.0666667
Effort	60	0.266667
Frustration	45	0.2
Total Workload	57.3333	
Dual task		
Mental Demand	45	0.266667
Physical Demand	20	0
Temporal Demand	45	0.2
Performance	80	0.0666667
Effort	65	0.333333
Frustration	55	0.133333
Total Workload	55.3333	
Subject 36		
SWAN single task		
Mental Demand	70	0.266667
Physical Demand	15	0
Temporal Demand	80	0.266667
Performance	15	0.266667
Effort	70	0.133333
Frustration	30	0.0666667
Total Workload	55.3333	
Speech discrimination single task		
Mental Demand	100	0.266667
Physical Demand	5	0
Temporal Demand	30	0.0666667
Performance	90	0.133333
Effort	95	0.266667
Frustration	80	0.266667
Total Workload	87.3333	
Dual task		
Mental Demand	65	0.266667
Physical Demand	55	0

Temporal Demand	30	0.2
Performance	40	0.133333
Effort	70	0.333333
Frustration	40	0.0666667
Total Workload	54.6667	

APPENDIX D

DEMOGRAPHIC DATA

Subject #	Gender	Age
4	male	22
5	female	19
6	male	19
7	female	22
9	male	18
10	female	19
11	male	20
12	female	20
13	female	18
14	male	20
15	male	19
16	male	20
17	male	21
18	female	20
20	female	19
21	male	19
22	female	20
23	male	25
24	male	25
25	female	25
26	male	26
27	female	26
28	female	19
29	male	25
30	female	25
31	female	19
32	female	26
33	female	26
35	male	20
36	male	24
	Mean age	21.53333333

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